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FAILURE MODE AND EFFECT ANALYSIS ON JTF17 FUEL AND CONTROL SYSTEM. APPENDIX A.

PRATT AND WHITNEY AIRCRAFT WEST PALM BEACH FL

10 NOV 1966

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APPENDIX A

FAILURE MODE AND EFFECT ANALYSIS
ON
JTF17 FUEL AND CONTROL SYSTEM



Pratt & Whitney Aircraft DIVISION OF UNITED AIRCRAFT CORPORATION FLORIDA RESEARCH AND DEVELOPMENT CENTER

rinted in the United States of America

Pratt & Whitney Aircraft PDS-2025

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INTRODUCTION

This study was made concurrent with design studies of the fuel and control in this study was arbitrary and is not intended to reflect final component probability of malfunctions and reduce the seriousness of the consequences of the malfunction. Where possible, such corrective changes are indicated level, the selection of component vendors, and corrective changes required as the result of this study. In addition, the first revision will include Component vendor selection for inclusion system and concurrent with review of the proposals submitted by various vendors for a particular component. By necessity Lhis study represents a finite level of the continuing component designs and one proposal for vendor selection. This study has revealed some areas that did not conrevisions to the study will be made at six-month intervals beginning in July 1967. The first such revision will reflect a more complete design study made of a representative proposed JTF17 Fuel and Control System. hazard classification and design philosophy to preclude failure and to This preliminary Failure Modes and Effects Analysis report is the areas have been reviewed and design changes initiated to minimize the form to the fuilsafe requirements established for the system. These in this study, but some of the changes were not resolved in time for Follow-up is done on a continuing basis and future particular vendor component. incorporation. reduce hazard.

Section I presents the effects of component sense or signal failures on engine operation. This report is divided into two sections.

fold-out block diagram is contained at the beginning of this section that can be exposed while reading both sections of the report.

Section II presents the effects of detail part failures within each component. A description, analysis, and fold-out schematics are presented for each component with the schematics arranged to follow the analysis of the applicable component so that by prior exposure it may be viewed while reading the component material. The detail part Failure Mode Index Number assigned to each component part is identified both in the analysis and schematic for each component.

Each failure considered was examined for effect on the fuel and control system, method of detection, effect on the engine, effect on the aircraft, and crew action required. For purposes of this study, failures at three flight conditions were considered:

- . Committed sea level takeoff (0 to 6000 ft) with maximum augmentation on a $100^{\circ}F~\text{day}\,,$
- . Cruise at design flight conditions.
- 3. Lending at reduced nonaugmented power on a 100°F day.

Where possible the failure effect on the engine is shown at each of the above flight conditions as the maximum available thrust after the failure, $F_{\rm n}$, expressed as a percent of the normal maximum augmented thrust, $F_{\rm nma}$, at the same condition.

PENSON OF

Where applicable, problems after failure with respect to climb, descent, landing wave-off, landing reverser actuation, and shutdown of the engine after landing are also presented.

This study assumed at least the following engine instrumentation is available to the aircraft crew in order to detect a failure:

High compressor rotor speed (N₂)

Turbine discharge total temperature (T_{L7})

Engine pressure ratio (EPR)

Gas generator fuel flow

Duct heater fuel flow

Engine oil temperature

Duct nozzle position indicator

The majority of failures can be detected in flight by the aircraft crew with the above instrumentation. Some of the failures are detectable only on engine shutdown or during routine ground inspection and maintenance, and such methods of detection are included in this study.

Reverser-suppressor position

The following abbreviations and symbols are used in this report:

Sea level takeoff SLTO

Thrust

Normal maximum augmented thrust Fnma

Power lever angle PLA

Shut-off lever SOL Compressor discharge total air pressure Pt4

Duct heater total pressure Pt3 Duct heater static pressure P 83

Compressor inlet air total temperature Tt2

Turbine discharge total temperature T_{E7}

Low compressor rotor speed

High compressor rotor speed

Engine pressure ratio

Failure Effect on Aircraft Classifications

Premature engine removal PER

In-flight shutdown IFS

Inability to obtain a selected level of augmented thrust AF

Delay in dispatch or departure 00

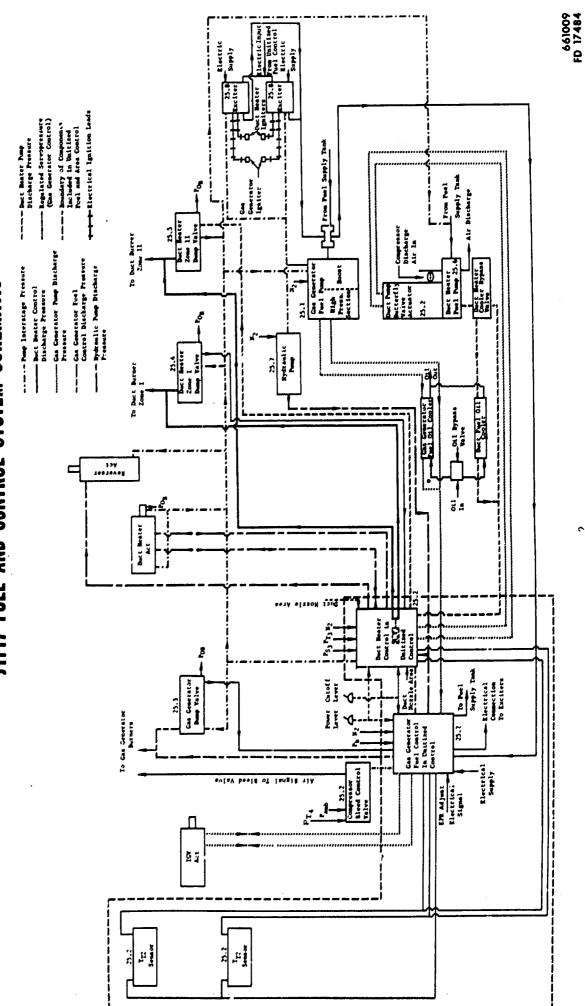
Repair or replace component without engine removal S

SECTION I EFFLCTS OF COMPONENT SENSE OR, SIGNAL FAILURES ON ENGINE OPERATION

This section presents the study of the effects of component sense or signal failures on engine operation. While experience with other Pratt & Whitney Aircraft engines has shown the majority of such failures will not occur in service, the probability of each failure is not negrifigible and may be caused by sense or signal carrying line failure or contamination blockage, shearing of drive gear sections due to overloads, fracture or seizing of rigging cable systems, fuel supply mismanagement or boost pump failure, or electrical systems opens or shorts. The use of a Failure Mode Index number was not felt to be applie. We for failures presented in this section, therefore a simple sequence numbering system was used.

The failure of a fuel carrying signal line could be the result of a significant external fuel leak of such line. Fuel leakage from such failures can be stopped by closing the aircraft valve that supplies fuel to the angine. When this valve is closed, fuel cooling of engine oil will not be possible. Each signal failure which could be the result of a fuel leak is marked by an asterisk.

JIFIT FUEL AND CONTROL SYSTEM SCHEMATIC



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ITF17 FAILURE MODE & EFFECT ANALYSIS

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Feilure Effect on Aircraft Coar Action Benefind	IFS Shows a second seco	Same as SLTO In-filebt eneme		Same at \$110	Same as SLIO Not Affected	Same as SLIO Not Affected IFS	Same as \$110 Not Affected IFS Same as \$110	Same as SLIO Not Affected IFS Same as SLIO Same as SLIO
Feilers Effect on Engine	3 5	Cas generator and duct heat-	er tiame out. Engine oil traperature will increase and exceed limits without crew action.	ser fiame out. Englise oil competative will increase and exceed limits without crew action. Same as SUIO	ser flame out. fogste out caperature will directate and exceed liefts without crew action. Same as SLIO Not Affected			
Serbed of D. action	2 4 8 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Same as SLTO		Same 48 5LTO	Same as SLIO	Same as SLIO None Engine performance deterioration with eventual gas generator and duct heater flame out.	Same as SLIO None Engine performance deterioration with eventual gas generator and duct heater flame out.	Same as SLIO
Failure Effect on Subscriben	ultant ultant		suitant duct mater solt- off. Insufficient to solers flow to engine oil coolers		suitant duct meater sour- flow to engine oil coolern flow to engine oil coolern Same as SITO supps can operate satis- terorily with an inlet resure of 5 psi above the ssolute wapor pressure of se fuel or at a wapor- te quid ratio of 0.45.	suitant duct master sour- off. Insufficient fuel flow to engine oil coolers flow to engine oil coolers The pumps can operate satis- factorily with an inlet pressure of 5 psi above the absolute vapor pressure of the fuel or at a vapo liquid ratio of 0.45. If inlet pressure of the fuel or at vapor-liquid ratio greater than 0.45, the pumps cavitate and cease to pump continuously.	suitant duct master suut- off. Insufficient fuel flow to engine oil coolers flow to engine oil coolers The pumps can operate satis- factorily with an inlet pressure of 5 psi above the absolute vapor pressure of the fuel or at a vapor. If inlet pressure of the fuel or at vapor. If inlet pressure of the fuel or at vapor liquid ratio greater than 0.45, the pumps cavitate and cease to pump continuously. :: Same as SIIO	surrand duct master suur- surrand duct master suur- flow to engine oil coolers The pumps can operate satis- factorily with an inlet pressure of 5 psi above the absolute vapor pressure of the fuel or at a vapor- ilquid ratio of 0.45. If inlet pressure is below 5 psi above the absolute vapor pressure of the fuel or at vapor-liquid ratio greater than 0.45, the pumps cavitate and cease to pump continuously. :: Same as SITO
Hon Faction Faction	ional Drive Failure and Drive				To supply fuel under Reduced Inlet S a positive head to the Pressure engine fuel pumps. (Boost Pumps	lalet Pps	in i	n p e
1	Drive Gen- Fuel				2. Engine Fust Supply Pressure			

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JTF17 FAILURE MODE & EFFECT ANALYSIS

Component Sens	Component Sense or Signal Failures (Continued)	follors Mode	Follere Effect on Subsystem	Method of Detection	Failure Effect on Engine	follure Effect on Aircraft	Crew Action Required
			Gruise: Complete loss of gas gene - Same as SLTO rator fuel flow and resul- rant duck hatter shutoff. Insufficient duel flow to engine cil coolers.	Same as SLTO	fas Generator and doct heater I lane out. Engine oil ter- por rature will increase and may exceed limits	Same as \$110	Inflight engane unfoldown If for- unfoldown If for- unfoldown If for- restored and engine Ny level on the Alfacted enganes to be an inflight enganes that enganes of lemperature of lemperature of lemperature of lemperature left engerature lest engerature
			Lending: Some as SLTO	Same as SLTO	Same an SLTO	Same as SLIO	Save an SLIO
4. Compressor Bleed Air Supely to Duct Heater Fuel Pump	Energy Supply to Drive Duct Heater Fuel Pump	Complete Loss of Pump Air Supply	SLTO: Loss of duct heater fuel flow if on or cannot be initiated if off.	Loss of duct heater (uel flow if on or cannot be initiated if off.	Duct heater will flame out if on or cannot be initiated if off. F _N = 60% F _N ^{MA}	٧٤	Reduce to and/or maintain non aug- mented. PLA range. Adjust P _N level or musifiected engines to obtain desired.
			Cruise: Same as SLTO	Senc as SLIO	Same as SLTO except FM = 201 FwW. In addition oil temperature will increase and may eventually exceed limits due to lose of dutt heater oil cooler fuel flow.	Same as SLYO Also may have IFS	Reduce to and sain- tain non augmented PLA tanpe Adjust Fy level on ur- afferced engines to obtain desired arr- craft conditions. Synitor engine . Ill te-persure. Ill te-persure. It tan engine cui tempersure livit tann engine cui tempersure livit tempersure livit speed to autsonic conditions.
			Landing: Not Afracted Duct heater fuel flow not available.	Not Affected	Not Affected If maximum F _N desired, assected SLIO	Same as 51.10	None 1f maximum F _N devired, Same as \$1.10
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JTF17 FAILURE MODE & EFFECT ANALYSIS

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Component Sense	Congouent Sense or Signal Failures (Continued)	f Inurd)	failure Effect on Subayatom	Method of Detection	follors Effect on Engine	Follure Effect on Aircraft	Crew Action Boquired
5 Speed Drive to Hydraulic Pump	Provides Rotational Frency to the Hydraul- ic fump	Drive Fallure	SLIO; Will cause pumping failure resulting in complete loss of hydraulic pressure. Duct nozzle nows to oper portitor	Duct nozzle to open position.	N ₁ higher than normal F _N = 902 F _N MA	**************************************	Adjust Fy Level on unifected engines to obtain desired
			Cruise - Same as SLTO	Same as SL10	Same an SLIO except F _N - 851 MA	Same as \$LTO	Save 40 SLTO
			fauding: Samu as 5,70. In addition, reverser- suppressor actuation not available.	Same as SLTO, In addition, reverser- auppressor cannot be actuated.	Some reduction in Fg. Ni higher than normal. Reverse Fg. not available. If maxi- mun Fg. desired, same as SLIC	Same as \$170	Adjust FLA to ob- ing F. If reverse F. dealred, relate F. dealred, relate FLA to idle and ad- just F. level on un- affected engines to obtain desired air- craft conditions. If maximum F. de- hired, ame &s SITO
6 Speed Drive to Unitied Control	Supplies a totational high rotor speed agnal to ve gas gan erdor speed sensor to achedule gas gruerator fuel flow/burner pros- rure as a function of apsed.	Sense of Spreed	SLIO: Gas generator fuel flou- ietto scheduled by the failustic plateau with trans- lition to plateau generally- it, decreasing ratio disc- tion. Sleeds and inlet guide vance scheduled by failuse plateau. Lose duct heater fuel flow if on or cannot initiate if off.	N2, 17, and EPR lower than normal. Duct heater abus off if on tennot be initiated if off.	FN - 35% FNIM	1	Decrease to and/or assistant non-augranted PLA range. Adjust FN level on to and feeted on the confines to obtain desired alreraft condition.
			Cruise: Same as SLTO	Same as SLTO	FN - 5% FNMA	Same as SLTO	Same as \$£70
-			Lending: Same ca SLTO	Same as SL10	Same & SLTO	Same as SLTO	Same as SLTO
7. Ph Sense to Unitized Control	Primary combuston prepare some which blasse (us) for to provide the proper fusylatir ratio to the gas generator and duct haster	a. Partial loss of Pa sense (alight leak)	SLIG: Reduction in gas generator N2, T ₁₂ and EPR lower and duck heater full filow and man normal. Gas generator of lower effect. erator and duck heater twe Pg. Reduction dependent fuel flow lower than on amount of Pg sense loss.	N2. T ₂ and EPR lower transmissing Gas gen- erator and duct heater fuel flow lower than normal	No. 172 and EPR lower than normal. Loss of thrust. Reduction dependent on amount of Ps sense loss.	if PB sense loss is alguificant, AF.	Adjustment of manual strengt ER control vill compensit for PB sense loss.
		•	Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	Same as \$LTO
			Landing: Semo as SLTO	Same as 5LTO	Same as SLIO	Same as \$170	Same as \$170
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Language State of Market Conclusion (1982) Language State of Lang	Shoe' I			JIFTY FAILURE MODE & EFFECT ANALYSIS	R EFFECT ANALYSIS		2	No of
Inserting Table	entent Sense	or Signal Pallures (Cont	(ponuja	;	-	7 100	-	•
The control by Gas generator and duct be a given to white the control by the cont	ŧ	Feaction	Follore Made					Crew Action Required
The first cerv command loan of power SLTD control by Ears as SLTD control of Grant Control by SLTD control by	. P. S nac to Unitized Cor, col (Continued)		b. Complete toss of R. sense	SLT0:	Gas generator and duct brater flameout. Gas generator minimum fuel flow if relight attempted.	d duct		In-flight engine shut, down, Adjust Fn level on unaffected engines to obtain desired affected affections.
Landing: Same as SITO Landing: Same as SITO Landing: Same as SITO Contact typic of failure 12, blass of failure				Cruise: Same as SLTO	My, Try and EPR lower than normal, Gas generator and duct heater fuel flows	Fn " -107, Fnsa.	i . <	Adjust In level on unaffected engines to obtain desired afrecaft conditions.
Alreafi crow corrend loss of power SLTD Sonted pates will read in the control of origine system. Alreafi crow corrend loss of power SLTD Sonted system will read in the control system. Cruites Same as SLTD control system. Cruites Same as SLTD control system. Cruites Same as SLTD control system. Alreafi crow corrend loss of about statement of the control of cruites Same as SLTD control system. Alreafi crow corrend loss of about statement of the cruit statement of the cruites SLTD control system operation					lover than normal.	On descent will eventually have gas generator flanc- out.	IFS	In-flight shutdown, Adjust En level on un- afficied engines to obtain desired air- craft conditions.
Alterait ceve command loss of power states will remain to control bytem				Landing: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO
Landing: Save as SLTO Landing: Save as SLTO Landing: Save as SLTO Save as SLTO. In addition, Save as SLTO Save as SLTO. In addition, Save as SLTO Save as SLTO. In addition, Save as SLTO actuated Alterate Grav corrected loss of shut: Alterate Grav corrected loss of shut: Input to salvet engine off lever input an or off conditions, to control ayatem, or fallure to build day and a state of fallure to subject of the same as SLTO Frovision for air- craft crav dayatement and doct for finel adjustaent. Arterate Grav corrected and state of the save as SLTO Frovision for air- craft crav dayatement and doct craft crav dayatement and doct craft crav dayatement adjustaent. Arterated Grav corrected and doct craft crav dayatement adjustaent adjustaent adjustaent capability. Cruise: Same as SLTO	Lever	Aircraft crew command Input to control system,			No control of engine power actifum.	Engine pover rerains at secting extaining at time of failure. Tre bias of pover secting continues to function.	Not affected at condi- line scienting at time of failure, if addi- tional power ceatred, AP.	None of conditions existing at the of failure. If power change desired, adjust for level on unaffected engines to obtain orative attests condi- tions. Engine can be shut down with 901.
It. Aircraft Grav correado Losa of Shut: Aircraft Grav correado Losa of Shut: In provision for air- Coulse: Same as SLTO Frovision for air- Craft Craft Adjustment. Authority. Cruise: Same as SLTO Cruise: Same as				Cruise: Same as SLTO	Same 43 SLTO	Same as SLTO	Same as SLTO	Same as SLTU
It affected drew correspond loss of shut. Input to select engine off levor input on affected, Mill require on affected, Mill require on or off conditions. In or off conditions. To control use of aircraft fuel vaive on engine. Same as SLTO Frovision for air- To control use of shut down engine. Same as SLTO Frovision for air- Tabling Sare as SLTO Frovision for air- Tabling Sare as SLTO Frovision for air- To control use of shut down engine. Same as SLTO Same as				Landing: Same as SLTO. In addition, rnversor-suppressor actuation not available.	Same as SLTO. In addi- tion, roverser- suppressor cannot be actuated.	Same as SLTO. In addition, .everse thrust not available.		Sine as \$1.70
Frovision for air- Tanding: Sare as SLTO Frovision for air- Tanding: Not affected Sare as SLTO	Engine Shut- off Levor	Afreraft drew corrund input to select engine on or off conditions.	Loss of shut- off lever input to control system.	SLT0;	Carnot shut down engine with 50L.	Engine operation not affected, Cannot shut down engine with 501.	Not affected	None, Use atterat fuel value when engine shut down desired.
Provision for air— a. Failure to SLTO Gas generator and duct call flow, duct heater to Italy gas generator fuel flow, duct heater to Italy gas generator adjustment capability. Cruise: Same as SLTO Cruise: Same as SLTO Not affected, if maximum Not affected, and as SLTO. Findestred, same as SLTO.				Crittee: Sare as SLTO	Same as SLTO	SARRO AS SLTO	Not affected	Sa've as SLTO
Provision for air— a. Failure to SLTO: Gas generator and duct the facility of the formal Lower than foul flow, duct heater to finate the formal Lower than foul flow, duct heater the formal Lower than adjustment capability. Cruise: Sanc as SLTO Cruise: Sanc as SLTO Landing: Not affected. If easierd Fination of the footed of the foote				Landing: Same as SLTO	Same as SLTO	Same as SLTO	Not affected	Same an SI fo
Same an SLTO Fm 63% Fmas. Same as SLTO Not affected Not affected Fm desired, same as SLTO.	Harial Re- mote Eff Control	Provision for air- craft crew adjustment of EFR by gas genera- tor fuel adjustment.		SLTO: Gas generator and duct heater fuel flow lower than normal. Lose resote EFR adjustewnt capability.	12, gas generator fuel flow, duct heater fuel flow, EFR, and Ity, all lover than norral.	Fn = 752 Frena.	.	Adjust En level on on- affected engines to obtain desired afferaft conditions.
Not affected Not affected. If maximum Not affected Fn desired, same as SLTO.				Cruise: Same as SLTO	Same an SLTO	Fn . 85% Fras.	Same as SLTO	Same as SLTO
				Landing: Not affected, If maximum Fn deafred, same as SLTO.	Not affected	Not affected. If maximum Fn desired, same as SLTO.	Not affected	None, If maximum En- desired, same as SLTO.

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ITFIT FAILURE MODE & EFFECT ANALYSIS

Sheet J			JTF17 FAILURE MODE & EFFECT ANALYSIS	EFFECT ANALYSIS		ž	No of
Component Sense :	Component tenne or Signal Failures (Continued)	Inned)	-	-	•	•	
=	function	failure Mede	Fallure Effect on Subsystem	Method of Detection	failure Ellect on Engine	foilure Effect on Aircraft	Crew Action Lequired
11. Hannal Resette Buct Beater Finel Plex Adjustment (Centlined)		b. Failur, to full in- treame datherity.	SLOT beet heater fuel flav yreater than wersal, hose recote duct heater fuel flow adjust ment capability.	fact heater fact flow and dust neggle area larger than nother! Lose re sete duct heater fact free adjustment capability.	Dar brater furl flow higher than normal.	Sone	Reduce 1915 or affected engine
			Crutaci Same as SLTO	Same on SLTO	Same an MAO except: For 1053 Forst	None	Same as sixo
-			Landings See applicable, if rund- care En dealred, name an Sirto.	Sary as SLTO	skfrun SLFO.	Not applicable	destred, sem as
-	- 10	c. Lusa of power aurph).	SLTD No temediate effect, Lone remate duct heater fuel floy adjustee it capability.	Lose femate duct heatifr fuel flow adjustment capability.	List rewree duct heatiff he ferestate effect. Lose fuel flow adjustment rewite duct heater fuel capability.	No Immediate offict.	Sone If duct heater fuel flow exceons denired level, re-
			Crutary Same in SLTO	Same as SLTO	Seme an SLTO	No tem diate effect.	Same as ALTO
			Landing: Not applicable. If waxi- may En desired, sair as \$1,70.	Same as SLTO	Not applicable. If castenillin desired, save as \$170.	Not applicable	None, If maximin Prodestred, same as
17. Manual Remited Total Airflood		full de-	Sirol Bot affected. This adjust- ment has no authority at Siro,	Not afferted	Not offected	Not affected	5 CM
	during augulated for.		Beefog either above approxi- vatel (200°F Ty), nubble area t as than nonfini-	Doei morrels area loss than normal, face semple duct norre adjustment capability	Total engine airline less than nordnal.	hasentially not affected.	Series
	- ~ ~ ~		Criter: Buct area less than number.	Duct nozzle area lene, than tentinal, lone remate duct nozzle adjustment capability	Total empine airflow less Essential than nominal, fin " 95, fines, affected.	Essentially not affected.	N. ne
_			Landing: Not applicable	Not applicable	Not at Micable	Not applicable	None
		b. fatlure to full to-	SLWy Not affected, this adjust- ment has not authority at SLW.	Not affected	Not 411 - 164	Not affected	Sone
		anthority	During climb shove 260°F Tezi duct meste area larger than gominal.	buct norric area driver than nowlest. Lose rewate duct merric adjust ant capability.	Total engine airflor larger than nominal.	Essential v not affected it inlet by ter ten accommutate ind cressed total engine altitur.	Bene
			Crutes than newlast.	buck murric area larger than mortnal. Lose recute duct norric adjustment capability.	Total engine airfine larger than nominal. In 35% home	facted if inter system forced if inter system factors and from the factors affiliately in affiliate in the factors affiliately in	None
			Landing: Not applicable	Not applicable	Rot ap, 'teable	Not applicable	None
					Amatriced by: White	When my the	12. 14. 14. 14.

JTF17 FALURE MODE & EFFECT ANALYSIS

Sheet I Contract Stank Factures (Contraced)

		Commence of the Commence of th			Marchael and President	
v Tuer von me	c. Lose of power supply.	SLTO: No immediate effect. Lese rem te duct nextle adjust- ment capability.	Low remote dust nor- tle adjustment capa- bility.	No immediate eifect, Lose remote duct nourle adjust- ment capability.	In imediate effect.	Kone
mir S. Ara. ++*	Minu menda	Cruise: Same as SUTO Landing: Not applicable	Same as SLTO Net applicable	Same as SLM Ave applicable	No immediate effect. Not applicable	Kone
ullized to accee and ullized to accee fan pressure ratio (RyPap)(Pp) for use in controlling total	a. Partial loss SITO: U. P. Partial loss SITO: U. C. P. Sensa.	SIR: Fan pressure ratio sense to control will be loser than actual ratio. But notale area larger than normal with increase dependent on anount of Pt.) sense loss.	Buct morele area larger than merul.	See increase in K ₁ and total engine airfles with increase dependent on amount of P ₁ sense loss.	Not affected	**************************************
ante filosoficio pare de disco	ne voor de state en voo	Cruise: Same as SLTO	Same as 5170	Same 41 SLTO	Not affected	If desired, adjust mozzle position with remite duct mozzle adjustment.
		Landing: Not affected	None	Not affected	het affreted	Kee
	b. Partial lova SLTO:	SLTO: Fan pressure ratio sense to control will be higher than actual ratio, Buct mozzle area less than exemi with decrease dependent on assurt of Pay sense loss.	Duct mottle area smaller than normal.	Some decrease in N ₁ and total engine airflow with reduction dependent on amount of P _{8,3} sense loss.	Not affected	None.
		Cruise: Same as SLTO	Same ets 9170	See 2. 9.70	Not affected	If destred, adjust mozale position with trente duct nozale adjustment.
	e description	Landing: Same as SLTO	Same as 51.70	Same as 51.70	Not affected	None
	c. Complete or significant less of P13 sense.	SLO: Fan pressure ratio sense to control willbe significantly lover than actual. Buct mesale area increases to maximus.	Duct nozzle arta la- cresse to vide open.	fretal engine airflos in- creased. N higher than normal. Fn * 905 Frana.	4	Adjust Falevel on un- affected engines to obtain desired air- craft conditions.
ang pambanan din , san , a makki ar ,apam , a	and the second s	Cruise: Spe as SLTO	D 13 ** **	Same as SLO except: Fn " 85% Frank.	If total engine air- flox correction desired, AF.	If total engine air- licus correction de- sired, adjust annual remote ER control or remote ER and adjust R, level on unaffected sired aircraft condi- tions.
	9	Landing: Not affected	Not affected	Not affected. If maximum F. desired, same as SLTO.	Not affected	None. If naxi- mar En desired, sare as \$170.

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Sheet I

JTF17 FAILURE MODE & EFFECT ANALYSIS

!	function	Pailvre Mode	Fellure Lifect on Subsystem	Method of Betection	failure Effect on Engine	Follore Effect on Afreroft	Crew Action Required
1), Fan Bischaige Free- sure (Fr) Senar to Unitized Con- trol		d. Complete or atgnificant loss of Paj	SLED; Fan pressure ratio sense to control will be significantly higher than actual. But nurse area decreased to minima area.	Duct nuzzle area to minican value. Engine surge during aug- mentation.	Engine aurge. After surge FIA correction: Fn = 65% frea	÷ <	Reduce to and or wifu- tain nonaugmented FLA Fange. Adjust In level on unaffected engines to obtain desified affectait
Fan Discharge			Cruise; Same as SLIO	Same as SLTO	Same an SLTO except: Fn = 20% Frms	Same as SLTO	Same an 41 To
Sense to Unitized Con- trol (Continued)			Landings Sane a > SLTO	Sanc an SLTO	If maximum F _n draited, same as SLTO,	Not alfected.	None. If maximum F desired, same as SLTO.
14. Dict Riggle Area Feedback Signal to	buct nuckle actual Complete loss area sense utilised of duct nursic co. control duct nursic area foudback area.	Complete loss of duct nessle area feedback	SLTD: burt nozzle scheduled to full open position,	Duct norse area to full open position.	Trial engine airfles in- creased Ni higher than normal. Fn = 90% Fina:	*	Adjust Fn level on unaffected engines to obtain desired affects.
Control			Crutars Same as 5130	Same as SLTO	Man an SLTO except:	Same as SLTO	Same as S.TO. If total engine airflow cerrection desired, adjust ton desired, adjust to in or reduce PA and adjust F. level on ne affected engines to obtain desired alreral
			Landing: Same as SLIO. If naximum Fn desired, same as SLIO.	Same an SLTO	Some Fig reduction, If waxious Fig desired, same as SLTO.	Keenefally not affected.	None, Increase 11A 1f destred, If maximin Fn destred, same as SLTO,
15. Electrical Sover Sup- plies to Egnikion Excitera	Source of electrical energy for apark lynifon of kas gen- orator and duct heater.	inver supply to gas penetator circuit.	NIO) Not affected, Redundant gas generator ignition system supply.	A voltage atgnal generator is provided in eath exciter to check each of the redundant gos generator circuite.	Not affected, Relight capa- bility of gas generator assured by redundant system,	Not affected	None
(7 Gas Gen-			Cruise: Same an SLTO	Same as SLTO	Same as SUTG	Same an SLTO	None
Duce Heater			Landing: Same as SL10	Same as SLTO	Sine as SLTO	Same as SLTO	None
(a b) Pádes		b, tons of power sup- ply to duct heater circuits.	SLTO: Lose duct hoater ignition capability.	A voltage signal generator is provided in each exciter to check duct heater circuits.	Not affected when failure occurs during duct heater operation.	Nut affected	Mone
				Atter duct heater shutoff, it cannot be relit.	After duct heater shutoff, it cannot be reignited. Yn - 65% Puwa:	ł.	Maintain noraugmented HA tenge. Adjust for level on unaffected engines to obtain de- sired affected

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Sheet)	Sheet 1 Commonent Sense of Viewal Pattures (Continued)	it (Bued)	JIFI7 FALUNE MODE & EFFECT ANALYSIS	& EFFECT ANALYSIS		4	
- I	fountière	Tailors Mode		Method of Detection	Politere Effect on Legino	fathers Effect on Aburuth	Crow Action Boquired
13 Electrical Four Sup-		,	Critaes Same as 51.70	Same as SLTU	Same as SiTO except if duct ships to be a 20% Press.	Same as SLTO	Same as SLTO
Kattere (2 Gas Generation and 1 Doct Heater Supples) (Continued)			Landing: Not affected, Duct heater limit on not uvailable.	Kot affect 2	Not affected. Maximum available Fn limited to SLTO conditions.	or affected	Mone, Same as SLTO if maximum Fr. desired.
00 1 17121 0011011111-1-44 mag 0 921 1 11110 lag 0 22101 000	***************************************				. 4.5%	11 1/1 35 12 12 12 12 12 12 12 12 12 12 12 12 12	14/1 35

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Sheet f. Cosponent Sense and Stanal Patlates (Continued)

JIF17 FAILURE MODE & EFFECT ANALYSIS

		Function	Pollere Mcde	Fallure Effect on Subsystem	Method of Detection	failure Elfact on Engine	follore Effect on Alexant	Crew Action Required
9	Gas Generator Hanifeld Brain Valve Struals							
•	Gas Generator Fuel Nesp Interstage Frements	Provides positive force Loss of pres- res actuals also held sure. Valve pistens in over- board drain closed position.	aure.	SLTO' Gas generator antifold distributed water this open of the part of the past drain port, Bost of the past generator fuel flowill be lost through the overhound drain.	Harbed reduction in Hy, Ity, and Eff. Engine ony not sentelly tracif. Excrative Tree gas gent rate; eantfeld draft valve.	Harked reduction in 81, 87, 17, and ERR, 80 will be insert and click or the engine we not available tracif.	*	Reduce 50 to 1f post- tion Adjust for ec- on and feeted continue to elitic desired sir- craft conditions
				Gruing: Some an SLTO	Sime as SLIV	Same on SLTO	Sale as NAO	Same as \$170.
ė	Fooltlening Signal Ford Ferrence	Signal level determines liens of pres- dials valve positioning sure or loss that presente for every of high ness-	Lone of pres-	SLTOL Bot affected Grutaes Hos, affected	Not affected Not affected	Not affected Not affected	Not affected Not affected	benr
	from Sal- tized Control	beard drain open and low pressure for over- board drain closed.	billty.	Landings Not affected, On engine aburdown residual fortunal not be drained from the gan generator mani-	Not affected, On engine austhorn no fuel dusp from air generator everboard drain	Not affected, May have chutcher for the maximum fire in magneral standardien section	Not afferted	None, If have shutdown fire, and it engine in atarter vith 50 in off position
-	17, Buct Heater Zone I Hant- teld Brain Valve Signals							
7 7 6	Car General tor Yel Tong foresting freshire	Provides positive force to actuate and foold valve pisten in the overhosted drain closed pusition.	aure.	SLTD: Buct havier Zone I canifold Interaction reduct facts weaker will upon the In duct fraction was been well upon the weaker will upon the Induct fraction will be a was found to the first of the Induction will be errorite due to the Induction was a was portion of the real manifold of the manifold dean value interace four plus due; manifold dean value portion of the treat fund (low being dueped the treat fund the weekbard death fund flust interaction white. Total aframm white fund aframm white fund aframm white fund aframment flust the weekbard death fundered flust interactions.	Interaction reduction and duct force force force force cacuratums. Excessive excuratums. Excessive excurband dann leskage from Zone i manifold drain valve.	Eratic duct burner opera- tion, At nomengmented 19A: Yn * 65% Yena-	÷	Reduce to and or bain- tion nonnegament TLA Trango, Advant En beel on unaffected engines to obtain desired attreat cordittins
	·			Gristne: Same an SUTU	Same an CLTO	Saze as \$170 except;	Sare as SLTO	SAM. At. 5270
				Landings Not affected, 13 reastern Pa desired, mano am SLIU.	None	Not affected. If eastern Fr. dealerd, name to SITO.	Not affected	None, If marked by destroit, same as 1570
•		*** (1) ********************************				Andres by Militar	Analysed by Marie Millian Millian Chillie	to state of

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		1	Feiber Office en Sabayatem	The Person	Table Shirt Salar	1	
To Prainting Store Store Feet	mark to the second second	Las of pres-	MIV: Me affected during doct heater operation.	Mene	he affected	Det affected	1
Darting Cates?	overhood drain cycles over control of the control o	Picker	in duct beater shirelf, residual fact will not be desined from the line I manifeld.	On doct heater shot- eff, no first damp from doct beater Time I. marifeld.	Evettal reking of Ime I foel muzies.	De effected	1
	t 42.50a	· ·	Craise: Same as \$270	Same 44 52.70	Same 48 SLTD	Act affected	ž.
is. Det Bester Leve II Beste feld Beste Talve Rignals	o conservação de la conservaçã	and the state of t	Landing: Not affected. If maximum fin desired, same as SLFO.		he affered. Majma f., to amila)': If desired.		1
*1. Cas Courator			SLIG: Door beater Lone II manifeld	Ł	Tratic det beren onen-		
Trians	using parties in ver-	The state of the s		above are transfer, in terralities reduction in duct bearer final flow and duct acrale coversione. Excession overboard drain leakage from Erre II manifold drain pret.	then at more transfer and above, Az more transfer: En " or France.		tale Leve I aspects tale RA renge :c tion RA renge :c towar. Missis & level to whale desired attach ceraft cené tions.
		T., .	Crime: Brenklin ner affected.	Scree	Remailty met affected.	Bermilly met affected.	in the second
		e Eliza de de Artago.	If RA range above some transfer desired, same as SLW.	er er er er	If NA range above some transfer desired, some as SLP except: Fn - 8th Fam.	-	li FLA range abere some transfer desired, some as SCF.
			Landing: Me affected, If naximum in desired, some as Mr.	č	If maximum Fa	Sec affected	Mos. If mainer En- desired, even a. C. N.
Strate Fact	Signal level determines Attain maine National		ARN: Me allected during due	Score	Not addressed	ورود ورود ورود	Mone
	in the state of th	And the state of t	On duct bearer reductive to live II shut off, residual fuel will not be drained from Lone II manifold.	On Line II shirtift, no feel donny from Line II overfheart drain.	On Love II shureff, no Eventual ceding of Rose II fort damp from Love II spraybars, overhoard drain.	Net affected	K-re
ند ند د	٠. ٠	€ m 3 vo vo 2 v 2	2996 € C	¥ 40- 10	w . M- 27 Grv	reference on or	

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15	Nem Sanse	Component Seast and Signal Past ster (Constituted) Hom Seast	famm d) Follore Mode	failure lifect on Soingstons	Method of Detection	fuilure Effect on Copins	Poliure Effect on Abstract	Craw Action Required
131	Beat Brates Res 11 Manss feet 1 prate			Certary Revealty not affected, 14 11A to a shown pour trains- for desired, same as 8170.	Kenn	Rewally not affected. If the tenne tenne. Its tange above tone tenne. for dealted, asses as MAD.	Not a ffected	.
\$ 27 2 300	Value Signals Fourthening Number of feri				Rent	Not affected, M. markage F., Smitted, and an 410,	Not affects t	, , ,
2 - 2	Remits 14.7 1 mail Mgnals					-		
£2253	Modulated for Pressure Nignals to Alliand	fuel present to multi- stated by eath remite- arises as that sach signal to proportional	lars of one street	WIND Ret affected. The reduciant. An indicating flag to Try system selects the highest provided to indicate of the two results arenes. I the two results are a select as a set on has failed. Civisa Same as MINO.	An indicating flag in provided to indicate thin one let benear system has falted.	Mit affected	that affected But affected	H. Y. A.
	Drain Fuel Freshire Freshire Freshire Freshire Freshire	Low pressure reforming sind pressure.	fluss of press sure to one sensor.	Landings Hame on ALTD	Name 44 1210	Not affering	Kut affected	**************************************
i i i i i	Results Duck Heater Defini- prop Gun- troller							
4	Speed First Speed First Pressure Signal from Unit Leid	Redulated fuel pres- acre algnal to one end or batterity walve at taker. This algnal level fortenest to treasing level fue	Loan of pres-	M.TO: Auctority valve publicated to authors position. Duep apped is increased of duet heater (set upter pretaire level to increase).	Ground therb of leitter of the calve practice in a dirace will show but telly valve open at middle fluid engline open at middle fluid engline open at middle engline open at middle engline.	fround there of leiters had affected. Burt heater the catter pestition in control will satisfact properties of the catter of the categories of the categorie	Not afferted	H.
		ducing butterfly open- tog in all aupply to toglogical utbine.		Cruins Same on MLTO Lawings Name on MLTO	Sans as MICO Sans as MICO	44.0 at 41.70 44.0 at 41.70	Has a 'sected Has a 'sected	H my
7		the plane well appropriate the Pale to the Medical Control of the	-			Andresd by:	المنافق المرادية المنافدات	1 25 WE

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į	Function	Failure Mode	Failure Effect on Subsystem	Method of Detection	Failure Effect on Lagine	Feilere Effect on Aircraft	Crew Action Required
20. Remote Duct Heater Turbu- purp Con- treller Signals (Centinued)						•	
*b. Increase Pump Speed Fuel Pressure Signal from Uritized Control	Acdulated fuel pressure signal to one end of butterfly valve actuator. This signal level increased to increase duct heater	loss of pressure.	SLTO: Butterfly valve positioned to but heater fuel flow minimum position. Pimp speed essentially zero. Butt reduced to low level. Butt heater shut off if on heater fuel flow reduced to or cannot be initiated essentially zero.		Fn - 652 Fn-4	YE.	Reduce to end/or main- tain nonaugmented PLA range. Adjust Fn level to unaffected engines to obtain desired air- craft conditions.
	the pressure level by reducting butterfly cpening in vir supply to turbopum, turbine.		Cruise: Same as 9170	Sine 25 SL70	Fn = 20% Frame. In addition, oil temperature will in- crease and may eventually exceed limits due to loss of duct heater oil cooler fuel flow.	Same as SLTO. Also, may have IFS.	Same as SLTO. In addi- from, monitor engine oil temperature, It may be necessary for ITS and to reduce aircraft speed to sub- sonic condition to prewnt exceeding oil temperature lisit.
Company			Landing: Same as SLTO	Same as SLTO	Not affected. If maximum Fn desired, same as SLTC.	Not affected	None. If maximum fn desired, same as SLIV.
*a. Start-Cruise Positioning Fuel Pres- sure Signal	Signal level of this signal and the SLTO positioning fuel pres- sure signal determine	Loss of pressure.	SLD: Not affected. Compressor inler guide vane positioning to normal schedule will be raintained by SLD signai.	None	Not affected	Not affected	None
from Uni- tized Conrrol	compressor inlet guide vane position. Start-	•	Cruise: Same ar SLTO	None	Not affected	Not affected	None
	cruise signal level light and SITO signal low for start-cruise position. The signals are rewreed for SITO position.		Landi: Sane as SLTO	None	Not affected	Not affected	None

Sheet

JTF17 FAILURE MODE & EFFECT ANALYSIS

omponent Sense	Component Sense and Signal Failure (Continued)	inced)					
Hem	Function	Failure Made	Failure Effect on Subsystem	Method of Detection	fuilure Effect on Engine	Feilere Effect on Aircraft	Crew Action Suppired
21. Compressor Inlet Guide Vane Actuator Signals (Continued)							
*b, SLTO Position ing Signal from Unitized Control	See previous func- tional description for start-cruise signal.	Loss of pressure.	SLTO: Compressor inlet guide vanes go to start-cruise position.	Nz higher than normal. Buct nozzle area less than normal. Buring augmentation engine	Fn = 407, Fn.13	*	Adjust F _n level on unaffected engines to obtain desired aircraft conditions.
			Cruise: No immediate effect.	None	No immediate effect.	No inmediate effect.	None
			On descent, the compressor inter guide vanes will remain at the start-cruise position.	During descent at normal SLTD position of compressor inlet guide vanes: Hinor increase in N2 and decrease in duct norzie area at lower three-fourths of nonagmented FLA range.	At lower three-fourths non- augmented PLA range, engine not appreciably affected.	Not apprectably affected.	None
				At upper quarter of nonaugmented PLA range. N2 increases and duct nozzle area decreases as az lititude and Tt2 decrease.	Some reduction in Fn with reduction becoming larger as altitude and I _{L2} decrease.	AF and CR	Adjust En level on affected engine,
				At augmented FLA range, Ny increase and duct nozzle decrease with as alitede and Tty decrease.	Some reduction in Fn with reduction becoming larger as a mitted and Tt2 decrease. Eventual engine aure limiting Fn to less than normal maximum nonaugmented.	Same as above	Adjust F _n level on affected engine and F _n level on unaffected engines to obtain desired afrecaft conditions. Affected engine eventually limited range.
			Landing: Not affected at N2 level where compressor inler guide vanes normally in start-cruise position.	None	Not affected	Not affected	None
			At No level where compressor inter guide wares nermally in SLD position, the vanes will to the start-cruiion.	Duct nozzle area less than normal. Ng higher than normal with devia- tion greater at high far range. Engine will surge if augmentation attempted.	Duct nozzle area less Fn = 40% Fama, Reverse Fn than normal viz higher lower than normal. I than normal vizh deviation greater at high Fuza range. Engine vill astree if augmentation attempted.	₹	Adjust Fn level on unaffected engines Lo obtain desired aircraft cenditions.
# 10 COLO PO PECO PE	as California services and a six color on about the				Analyzed by: Village 917/16	WITH The State	74 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

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JTF17 FAILURE MODE & EFFECT AMALYSIS

Sheet I

Not affected Not affected Not affected Not affected Compressor bleeds re- Signature of the state of the	Men Men	Stemant Stem did signal tailing (continued)	fellers Mede	Foilure Effect on Subsystem	Method of Detection	failure Effect on Englan	Feilere !Mec! on Alexant	Crow Action Cognitive
Designation of the presence to the compression of the control of t	22, Romote Com- pressor bleed Control Signals				:	***		1 T BOX 1 T B C B C B C B C B C B C B C B C B C B
Maintening signal level detect— Control Contro				alfO: Not affected. Compressor bleeds reasin in closed position. Gruise: Same as SLTO Landing: Same as NLTO	Rone None Caspressor bleeds re-	Not affected Sot affected So ismediate effect, Empine	Not affected Not affected No immediate, effect,	None None None Stengine augger
Death Full Law protestives on Laws of press. The proper actuation for the proper actual to proper actual proper actual to proper actual proper actual proper actual to proper actual p	Positicalny Air Signal to Copressor Bland Attuatorn		Loss of pres- sure or loss of confressor discharge att pressure port.ng capa- billty.		onto closed when 12 tranced to 1d1s.	nay surge dur'ng Accelera- tion while it, reverse or if eaxime in delited.	If agine surges, AF.	retard P.A. (n. 1dls. or abut off engine. Adjust Fn level on enaffected engines en obtain dearred aircraft conditions.
Signal fore signal fore determing of the pressure free differences of the pressure free differences of the pressure free determing of the pressure for determing the pressure for determine the pressure for the pressure for foreign and gas gone for the pressure for determine the pressure for foreign and gas gone for for foreign foreign for foreign for foreign for foreign foreign for foreign foreign foreign for foreign forei			Loss of prus-	SLTO: Not affected, Signal level opposed by apring so that proper attraction maintained, Grniae; Some as SLTO handlag; Same as SLTO	None Ren- None	dat affected Not affected Sot viewered	Not affected	None to the total
Attaction of press of	*c. Signal Fuel Preserve from Soutified Control			SLTO: Compressor bleeds to bleeds eyen position. Cruise: Same as SLTO Landing: Same as SLTO	N2, T(7, and EPR lower than norral. Same as SLTO Same as SLTO	Fn = 70% First Fn = 80% First Sync 48 \$1,70	AF Sanc as \$170 Sanc as \$1.70	Adjust En level on un- effected angines to brain desired air- frait conditions. Same as ALTO Same is 4170
Ing Everace thrust not available., Reverace thrust not available., Reverace thrust not available., Reverace thrust not available. Assimble on one position not available. Franction and Reverace thrust not available. Franction and Reverace thrust not available. Franction and available. Franction available. Franction available. Franction available.				SLTD: Not effected Gruine: Not affected	None	Not afrected Not affected	Not affected	Кола Хопа
	Contract	for Editable pres- sare for tworse paste and gos gor crator pasp take; pressure for forsed wealtien.	hility.	landly: Reverser supp.caser actuallen to reverse posttion not avsilable.	Camot retard FIA below reverse idle.	Reverse thrust not available.	Reverse thrust not available on one engine.	have received desired, resistant of the Adjust In level on word feeted engine to obtain desired air-craft condits as

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17F17 FAILURE MODE & EFFECT ANALYSIS

¥6 of	Crew Action Required		None	K's nr	3 3km Alulu
'	Follore Effect on Aircroft		Not affected		Mary 2011 The Shifts Shifts All Alle
	failure Effect on Engine		Not affected	Not affected	Anadyred by: Walter
a Little Amatica	Method of Detection		Rone	tion from reverse rears publishin o soccoluit storer nerval,	-
JILL TALLON, MODE & LITTLE ANALISIS	failure Effect on Subsystem		SLTO: But affected		Trans. 1881
:	Paters Mede		Loss of pros-		,
;	Component Sons, and algon Fallute (Continued) Hom Feetlen Foll		Permits saintaining	towerse position to forward parallele to forward parallele den signal pressure re- duced to low level and prevides holding forcel in the forward posit- flom.	And thinks the train of the beautiful and the train of th
Sheet: T	Genpental Season of	2), Reverber- Suppressor Actuator Struato (Continued)	*b, Gis Cenerator.	Pressure	

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EFFECTS OF DETAIL PART FAILURES WITHIN COMPONENTS SECTION II

such as housings, castings, Levers, rollers, cams, and springs are designed the probability of each failure is not negligible and may be caused by fuel This section presents the strdy of the effects of detail part failures based on experience, it was assumed that sliding seals used in this design Extensive experience with control system comwill not incur any significant wear within the specified overhaul period, While experience with other Pratt & Whitney Aircraft with sufficient margin to preclude their breakage. In making this study ponents of the type used in the JTF17 engine has shown that basic parts contamination, detail part distortion, bellows or diaphragm rupture, or it was assumed that failure of such parts will not occur. Similarly, engines has shown the majority of such failures will not occur in sticking of sliding parts. within components.

posn dund on the JS8 engine. The JTF17 duct heater fuel pump air turbine has the The duct heater fuel pump air curbine is similar to a fuel foliowing characteristics:

- The low cycle fatigue design criterion is 100,000 cycles.
- vortex venturi turbine exhaust limits turbine overspeed to 41,000 rpm at no loud conditions. The turbine burst speed The maximum normal turbine rotor speed is 27,500 rpm. ls 85,000 rpm

- 3. The turbine and bludes are machined from FWA 1005A Waspaloy forging. There are no through holes in the turbine disk.
- 4. A quality assurance spin proof test to 71,000 rpm will be performed on each finish machined turbine disk prior to assembly of the pump.

In view of the above, fracture of the out heater air turbine was not considered in making this study.

Each failure presented in this section has been assigned a Failure Mode Index number which will be utilized in the future collection of reliability information. Each number defines a unique part of the engine and consists of a series of digits such as 25.2.27.3.xx. This is the number assigned to the integrating piston and pilot valve of the unitized control duct heater fuel turbopump controller system. Such identification is arrived at in the following manner.

OLAN PA

ELANA LA

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Silventine Silventine

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Sacilla sip

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- The first series of digits identifies a particular engine section, in this case the fuel and control system. 25.
- The second series of digits identifies a particular assembly within the applicable engine faction, in this case the unitized control. .2.
- The third series of digits identifies a particular sub-assembly or sub-function within the assembly, in this case the duct heater fuel turbopump controller system. .27.
- particular detail part within the sub-assembly, in this case the integrating piston and pilot The fourth series of digits identifies a valve. ۳,
- last series of digits has not been included presented could be caused by more than one in this study since some of the failures to define the exact nature of the detail galling, fretting corrosion, etc. This series was felt to have no significance The last series of digits will be used method and the deletion of this digit part fallure such as contamination, for this study, ·××·

25.1 GAS GENERATOR FUEL JUNP

1. Description

The gas generator pump is an engine driven two-stage unit which incorporates a centrifugal boost stage in series with a single high pressure gear gear stage. The boost element supplies fuel to the high pressure gear the lydraulic pump inlet, the duct manifold quick-fill system and the ignition exciters for cooling. The high pressure stage supplies fuel to the unitized control where it is properly metered before being injected into the gas generator combustor. A small amount of this flow is also used by the unitized control computer section to power hydraulic servos and generate hydraulic aignals.

A 25-micron filter is incorporated at the boost stage discharge and a 200-mesh screen is located within the hydraulic and control bypass retarn flow path to the gear stage. Bypass valves are located in parallel eith the filter and the screen to provide a flow path in the event either become contaminated. An indicator is incorporated which produces a visual indication if the 25-micron filter pressure drop approaches the bypass condition.

A bypass valve is incorporated in parallel with the boost stage which opens in the event of impeller blockage to provide a low restriction flow path to the high pressure section. This will permit the pump to continue to operate on the main stage alone.

A relief valve is included at the pump discharge which opens to prevent excessive pump discharge pressure in event of a downstream malfunction.

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Act Peter

Two fuel outlets are provided on the pump. One is connected to the unitized control through the fuel-oil cooler and the other outlet is connected to the control through a flow divider valve.

cooler and associated plumbing resulting in a total system weight reduction. All additional flow beyond that required to maintain the 30 psf is bypassed fuel-oil cooler until the pressure drop across the cooler reaches 30 psi. The flow divider valve directs total pump discharge flow through the directly to the unitized control. This scheme reduces the size of the

Instrumentation pressure taps are provided at the pump inlet, filter inlet, filter discharge and gear stage discharge. These pressure taps may be used to obtain signals for cockpit instrumentation.

The pump drive spline is lubricated by oil supplied under pressure from the engine oil system.

feature permits the pump to be removed from the engine without disconnecting The pump design includes a quick-disconnect adaptor plate to which all the associated plumbing, and to assure the pump can be replaced the external fuel connections, except the main inlet, are made. installed engine in less than 30 minutes.

A schematic diagram and a cross-section view of the pump is presented following the analysis of the pump.

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Sheet 1 p. Albatysis			ITFIT FAILURE MODE & EFFECT ANALYSIS	& EFFECT ANALYSIS		Z	Ms
inen ceneral	forciles	Pollere Mode	Pollere Effect on Sobsystem	Mothed of Detection	fallure Illect on tagine	failure tifeet on Afreruft	Crew Action Required
Bornt Impeller	To prevent cavitation in the device supply to the year stage and the hydroutt pump by the results on the supply to these two for amply to these two for pumpling elevation. Also	123	M.TO: Fuel supply pressure to gas generator fuel purp was a tage and to hydraulic purp upply declares to englise falst busy free fuel better quick-full system and couling flow to tgnitten extiture.	No insection of the Charle to restrict to the control of the contr	No seme flate effect. Duct heater cannot be respittated after shoulds. For this later confittons. Fig. 632 p.m.s.	AF and CR	Some If dust heater about Most been readed Factor and adjust Fr Factor and adjust Fr Factor and adjust Fr Factor and adjust Fr Great on madfacted Great and adjust Great from the object Great from
	supplies fuel for duct hear randfald rapid felt sed confine fuel for tanklion exciters.		Crutaus same as 84,70	Same as SLTO	No impediate effect, Duct livator counct be reinitizated affect shut- off, For this later condition:	Varie 40 NUTU	oppose as skillo
					Also, atter probonged high M. operation, and lose gas generator religii capability due to lack of cooling flow to lack of cooling flow to lack of cooling flow	Hay result to 118.	In the event of gas generator flametali followed by inability to re- fight, follow in- flight, thicker short- down procedure.
			Landings Not affected Duct heater fuel flow nut available.	Not affected. Will not be able to refutitate duct beater	Hot affering. Haximon available Fn Hoffed Fn ** 05% Fnss	Not affected	None Sare as SENO 11 maximus In desired
Gest Posp 25,1,2	Sonites high pres- sure fuel to the gas gravestor control.	Gear pumping (Affure	SUID: Complete lugs of gas generator first flow and resultant duct heater shut off.	dae generator and duct heater flamenut. No pas generator fuel flee indication if religit attempted.	Gas generator and duct heater (lameout	IFS and CR	describing engine of at describing the level en under enginee to obtain de attent after a rafe conditions.
			Gruino: Goepheto losa of gas generator fuel flow and resultant duct heater shut off. Losufficient fuel fuel flow to cugine oil couleys.	Sanv an 51 70.	Gae generator and duit brager if amenou. Trighte oil temperature will finterer and may extend limite.	Sance as 51,70)	beddight open abut door, If necessary to maintaft of it per- ature lieft, poduce attitate speed to sobe- annia exciditions.
			Landings Same as SLTU	Sam as BLTO	0.170		3-der as \$13.0
B01 4 559 P4 B535-11 584	,	-	•	•	Andres by: Manne	defend that - Man the les.	138. Alle

JTF17 FALLINE MODE & EFFECT ANALYSIS

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1	Perction	Fallers Bade	Feilere Effect en Schopstem	Barbad of Detection	Feders Effect on Engine	Feilers Effect on Alexands	Cow Action Regal
Interstage Filter (25 micron) 25.1.3	Containation pro- tection. Filters bost tipeller discharge fuel flow.	Excessive contaminant deposited in illter.	SLTO: When fuel pressure drop across the filter exceeds a preset level, the filter bypass valve opens allowing fuel to bypass the filter. This permit contamination to enter the fuel and control system which may cause pump and control system deterioration depending on the contaminant.	Wee in flight. An external visual indi- cator is provided on the pump that is activated at a filter pressure drop level lower than the filter bypass valve opening level.	% (mmediate effect	No immediate effect CR	Mone Encesive contami- Lant in the filter and corrective ac- tion can be con- trolied in most instances by normal ground inspection and waintennee.
	The specific to		Landing: Same as SLTO	Same as 54.70	No immediate effect	No landiate effect	Se 22 22 23
Control Bypass Return and Hydrauli, System Return Strainer (200 cesh)	Contaniantion pro- tection. Strains return to interstage fiel flow from the control bypass and hedraulic system return.	Excessive Containant deposited in strainer.	SLO: When fuel pressure drop across the strainer exceeds, the strainer bypass valves open allowing fuel to bypass the strainer bypass valves open allowing fuel to bypass the strainer. This permits contamination to enter the fuel and control system which may cause pump and control system deterioration depending on the contaminant.	Excessive contant- nant in the strainer and corrective action can be controlled in most intenes by normal perfodic in- spection and mainte- nance.	No immediate effect	Ko imediate effect	N. Kob
	even self him .		Cruise: Same as SLTO Landing: Same as SLTO	None None	No immediate effect.	No immediate effect No immediate effect	See 25 273
Boost Impeller Bryass Valve 25.1.5	Provides a direct hypass path around the boost impeller in the event of boost impeller pumping failure.	Sint Glossd Position)	SLTO: We first order effect. In the event of a boost inpeller pumping failure (double failure) the firel supply to the gear stage will be through the impeller instead of a direct bypass path resulting in an increase in the pressure drop through the impeller states.	None on	Sot affected	7	X
			Cruise: Same as SITO Landing: Same as SITO	Wone Wase	Not affected Sot affected	Ne affected No affected	N N N
*** ***********************************	W. 13.17. Water 100 Mr. 1 4 h. 1111 & 185.11 14		•		Ambres by: Uthers	The Transition of the Party of	34 37

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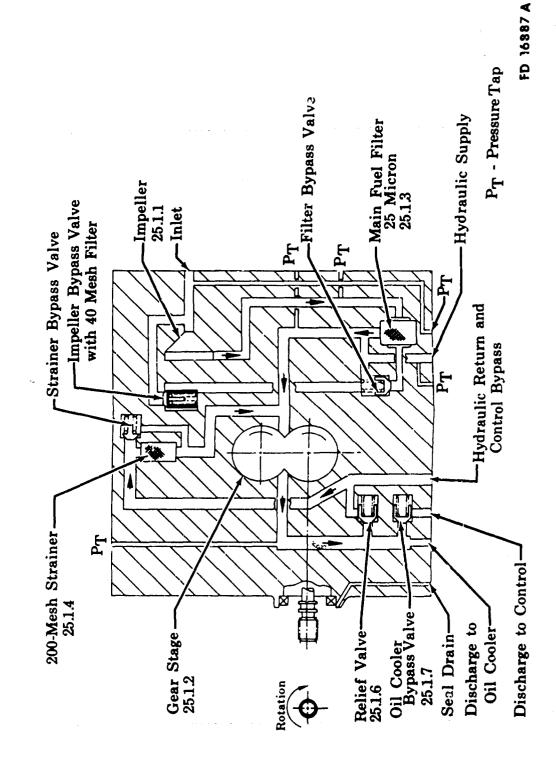
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Sheet I Gas Generator Fuel Boop (Continued)

JIFIT FAILURE MODE & EFFECT ANALYSIS

L Dalle Control of the Control of th	the Grant Piet Piet (Contributed)	_	•			•	
===	- June 11-m	fellere Mede	Failure Effect on Subsystem	Marked of Detection	fellore tilact on Ingline	Pollore Attect on Aircraft	Crew Action Required
Gear Post Raise Valve 25, 16	Provides fuel pressure refise (c. 1 not que generator fuel notes pressure for a notation and love in the event of abnoval: titles that attervise could result in excessive system (ue)	(closed post)	MID) No first exist effect, in the weath of abuncant- lities of the gra senerated for system resulting to an intrass in system pressure (double fallure) the system pres- sure layed evoid become examities.	Мине	Not afferted	Mut affected	Non
			Crutest Same as 30.70	Kone	Not afforted	Not affected	N. de Nese
Oll Gelet Fiel Klass Valve O 1.7	frivite variable, for the key property of control control of contr	by Server	ALT.) All pump discharge fund is directed through the an accordance in conference fund for personal is increased in pump relief of a personal in pump relief of a conference in pump relief of a conference in the pump relief of a conference in the according. Moreover the according and the according and the according and the according and according a second according to the according a second according to the according a second according to the ac	Rene	Not affected	Sec offerred	No. 11.
			Chilary Save as SLIC	Kena	hat affected	Not allested	Nous
			Landing; take as NiTO, satept pressure the pressure in intrabase less at the same of supplier spend sufficient	Hereise	Not affected	Not affects &	Note
		b) telante in cren profit on,	Martin dan menerator telt teoler bytes for the first conditions. Post flow effections. Post flow effections for teoler flow flow deligible tell teoler flow deligible to	Bone	Not affected, Old couler fund they to adequate for 'il couldny,	Not affected	*** **** **** **** **** **** **** **** ****
			Chilial Hans de SLED	* Kens	Name an 41.70	Not affected	None
	•		landinas Save as 81,70	Mitte	11. to a 4. to	Mrt allected	Hone
-			~ -		Ambried by: Allegan	Spirite The Spirite	18 196

Gas Generator Fuel Pump



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25.2 UNITIZED FUEL AND AREA CONTROL

A. Description

The unitized fuel and area control is the major component of the control system for the JTF17 engine and incorporates all of the primary and most of the secondary controlling functions of the system.

The JTF17 engine control has the following basic functions:

- 1. Controls engine speed, turbine inlet temperature. and engine thrust between full reverse and maximum duct augmentation power as a function of PLA.
- 2. Schedules gas generator fuel flow rates during acceleration or deceleration to keep engine operating conditions within acceptable limits during transient operations.
- 3. Positions the duct heater exhaust nozzle area to maintain the design corrected total engine an flow schedule.
- 4. Positions the high compressor inlet guide vanes as a function of engine inlet temperature and high rotor speed.
- 5. Positions the compressor bleeds as a function of high rotor speed and engine inlet temperature.
- Positions the thrust reverser-suppressor as a function of power lever angle.
- . Provides for fuel cutoff at engine shutdown.
- 3. Controls the speed of the duct heater fuel pump to the minimum required to provide duct fuel pressure and flow.

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The main component of the control system houses all ci the engine control functions described above and is referred to as the unitized control. Four separately mounted components are utilized. These components are:

- . A Lurbopump controller signaled by the unitized control to control duct heater fuel pump air supply by modulating a butterfly valve located in the pump air inlet supply.
- 2. Two engine inlet temperature sensors which sense temperature with gas-filled tube. The resultant gas pressure is transduced into a fluid pressure and in turn sensed by the unitized control for use as engine inlet temperature bias.
- A compressor bleed control valve which ports compressor discharge pressure or nacelle ambient pressure to the compressor bleed actuator as signaled by the unitized control.

The unitized control is supplied with fuel pressure and flow by three pumps: (1) a gear-type pump to supply fuel to the gas generator, (2) a centrifugal fuel pump to supply fuel to the duct heater, and (3) a pistentype pump to provide hydraulic pressure for duct heater exhaust nozzle and reverser-suppressor clamshell operation.

pressure ratio is provided to permit adjustment of gas generator pressure mechanical and consist of a single lever controlling forward and reverse thrust, and a separate lever controlling fuel cutoff. Remote setting of Power command inputs from the airframe to the unitized control are ratio in the maximum nonaugmented and the augmented regions.

and engine. Fuel is metered to the gas generator to set the desired engine duct heater exhaust nozzle is positioned to provide control of total engane is metered to the duct heater to set the desired thrust argmentation. The one cam linkage system that responds to input signals from the aircraft pressure ratio (EPR) for both augmented and nonaugmented operation. Fuel airflow. Schedules are included to sequence the (1) reverser-suppressor The unitized control performs all the required computing functions system, (2) high compressor inlet guide vanes position, (3) compressor bleed position, and (4) duct heater ignition system.

response to the input signals. A constant pressure drop is maintained across this valve by the pressure regulating valve which bypasses excess fuel back The scheduled gas generator fuel flow is metered by the throttle valve, which is positioned by the computer portion of the unitized control in to pump interstage pressure.

This opens a supplementary This bypass d fuel is retuined to the aircraft gas generator bypass port when the fuel temperature at the control inlet exceeds 300°F protect the system from excessive fuel temperature, a thermal for gas generator flows of less than 5000 pph and 360°F tor control is incorporated in the unitized control. flows greater than 5000 pph.

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ministration of the desirability of the second of the seco

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system as required to prevent excessive temperature in the engine fuel

lever and computer system inputs when the shutofi lever is in the fuel Fuel is metered to the gas generator burner in response to power "on" position. Starting, accelerating, speed governing, and decelerating schedules are used to regulate this flow to protect the engine from overtemperature and The cam is translated provided for the high speed rotor by a steep overspeed droop slope in the contour provides a schedule of fuel/air ratio (Wf/Pb) that is multiplied For starting and acceleration to the desired by primary combustor pressure, (Pb), to provide fuel flows to safely accelerate the engine in the minimum time. Overspeed protection is by high rotor speed and is rotated by engine inlet temperature. speed, an acceleration scheduling cam is provided. overstiess at all times. acceleration cam

At idle, the governed speed can be adjusted with a manual ground adjustment on the governor which senses high rotor speed. This governed speed is selected At all power settings below those that require maximum turbine temperature, the gas generator fuel flow is regulated by a proportional by the power lever angle and brased by engine inlet temperature. unitized control to permit trimming of engine idle speed.

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Table 1

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At steady-state maximum nonaugmented and all augmented conditions the gas generator fuel/air ratio is scheduled as a function of engine inlet temperature and high rotor speed to provide the desired engine pressure ratio. The delivered fuel can be manually adjusted if desired to permit adjusting gas generator pressure ratio in the duct augmented range and maximum nonaugmented range.

The high compressor inlet guide vanes are positioned in one of two positions by a hydraulic fuel actuator. Cruise and takeoff positions are automatically scheduled as a function of high rotor speed and engine inlet temperature.

The compressor bleed actuators are positioned by incumatic pressure directed by an externally mounted control valve which is signaled by fluid pressure signals from the unitized control. Bleeds open and closed positions are automatically scheduled as a function of high rotor speed and engine inlet temperature.

The reverser-suppressor is actuated by hydraulic fuel actuators. Takeoff and reverse positions are selected by power lever positions.

The desired duct fuel flow is scheduled by the duct control metering valve. A throttling type regulating valve maintains a constant pressure drop across the metering valve. To minimize the amount of throttling required in the unitized control, and heat rejection to the fuel, the air supply to the duct heater turbopump is modulated to vary pump rpm as required to hold a constant pressure drop across the complete duct fuel control metering section at all engine power settings.

Power lever translates a 3-D cam and destred duct heater fuel flow burner pressure ratio $(\mathrm{W}_1/\mathrm{P}_\mathrm{b})$. This ratio multiplied by burner pressure $(P_{\rm b})$ resulting in a signal proportional engine inlet temperature rotates the cam, the output of which is the Fuel is metered to the duct heater as a function of power lever position and engine inlet temperature. to fuel flow being generated.

The duct heater incorporates two zones of fuel injection. Within the unitized control, each zone is provided with a fuel shutoff valve and a manifold rapid fill system. This latter system reduces by a very significant amount the time required for augmentor transients by providing a high rate of fuel flow from the gas generator boost pump during the fill period. Each zone is also provided with separate fuel pressure signals for operating the fuel manifold dump valves.

parti 11y open, and (5) the duct igniters are energized. Fuel is delivered indicates the manifold is full. The rapid fill valve closes, the igniters to the Zone I fuel manifold at a high flow rate until a pressure signal When the power lever is advanced beyond the maximum nonaugmentation (3) the Zone I shutoff valve opens, (4) the duct exhaust negzle resets flat to the minimum duct augmentation flat, a sequencing valve in the unitized fuel control unitiates the following events: (1) the Zone I manifold dump valve closes, (2) the Zone I rapid-1111 valve opens, are turned off, and the duct exhaust nozzle reset is removed.

If the power lever is moved to the Zone II range the (I) /one II Further power lever advancement increases duct fuer/in ratio and duct nozzle area on a coordinated schedule to hold the total engine airflow

Il tuel manifold. advancement causes increased duct beater tuel flow, increased engine thrust, for quick filling of both the Zone I and Zone II fuel manifolds is supplied Maximum duct augmentation is scheduled by power lever position. Fuel flow and Zone 11 by the fuel nozzle flow characteristics. Zone 11 fuel ignites A constant fuel/air ratio is held during the Zone II rapid-fill transient a closing of the rapid-fill valve and simultaneously routing metered fuel fuel manifold dump valve is closed, (2) Zone II shutoff valve is opened, to the Zone II manifold Total duct fuel flow is divided between Zone I Pressure increasing in the Zone II manifold provides a signal resulting spontaneously when the fuel enters the burner. Continued power lever and increased duct nozzle area to maintain constant engine airflow. and (3) Zone II rapid-fill valve is opened to fill the Zone from interstage pressure of the gas generator fuel pump.

The total corrected engine airilow is controlled as a function of engine nozzle. In the cruise range the nominal antilow schedule may be manually adjusted by the flight crew between maximum and minimum limits to obtain inlet temperature to the schedule—defined in the engine specification. the lirflow control is achieved by actuating the variable duct exhaust optimum inlet performance.

arrilow. Gas generator airflow is determined by sensing high rotor speed and engine inlet temperature. Knowing this airflow permits determining Therefore, desired duct airflow will be scheduled as a function of bigh the duct airflow required to obtain the d sared total engine airflow. Total engine airtlow is the sum of gas generator airtlow and duc rotor speed and engine inlet temperature.

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The duct corrected airthow is measured using the duct pressure ratio parameter, this being the difference between fan discharge total pressure, and tan discharge static pressure divided by fan discharge total pressure, $(P_{i,j}, P_{i,j})/P_{i,j}$. The unitized control schedules the duct pressure ratio meassary to obtain the desired duct airthow. The actual duct pressure ratio pressure ratio. The difference between the pressure ratios initiates corrective action through a proportional plus integral servo and a power boost servo to reposition the duct exhaust negale as required in a closed loop basis to obtain the desired duct airthow.

A schematic of the unitized control is presented following the analysis of the control.

B. ANALYSIS 25.2 Unitized Control							
1	Fraction	Tallere Made	Feilere Effect on Solsystem	Method of Detection	Fullert Effect on Engine	Federa (Stact on Aircraft	Cree Action Depaired
Shutoff Lever		Seimre	SLTO: Not affected	None	Not affected	Not affected	None
Sequencing Valve			Cruise: Not affected	None	Not affected	Not affected	None
	valve functions.		Landing: Not offected, Engine can	SOL torque increase	Not affected	Net affected	None
			to mechanical connection	to ment out engine.			
			of sequencing valve. SOL torque will increase.				
Power Lever	Provides, vith minimum						
Boost and	input torque, control						
System	and power level and						
25.2.2	courtol of augmenta-						
	tion. Also provides sequencing of reverser-						
	suppressor.						
Power Lever	Controls the power	Seizure	SLTO: Not affected. Control sys-	Increase in MA input	M., affected	đ	None
Valve	function of input		maintained by mechanical	rothor.			
25.2.2.3	ź		drive of MA can shaft either				
			carcula the selfate of by the override torque key. Torque				
			required to move MA vill increase.				
			Cruise: Same as SLTO	Same as 52.70	Not affected	Same as 52.70	Xcoe
		-	Landing: Same as SLTO	Same as 52.70	Not affected	Same as SLD	None
Power lever	Provides power boost	Se la la	SLTO: Control system remains at	No control of engine	Engine power remains at	CA. If additional	None at conditions
Boost Power	rotation of PLA can		setting existing at time	power setting.	setting existing at time	pover desired, M.	existing at time of
Piston 25.2.2.2	shaft in response to		of failure. Try bias of schedules will continue		of failure, Tr2 bias of power setting continues to		failure, it pover change desired, admen
	control valve.		to function.		function.		Fa level on unaffected
							desired aircraft con-
							shut down with SOL.
			Crutse: Same as SLTO	Same as SLTO	Str 25 SL70	Same as SLTO	Same as 51.70
			Landing: Same as SLTO. In addi-	Same as 52.70	Same as SLTO. In addition,	OLTS ** ***	State at 5270
			tion, reverser-suppressor		reverse thrust not available.		
* *************************************	and 1575; emplitably and 5 mp.; sitte an address can				Landond by Whom Should	South Fe state	14 dilb 34.

经验的情况的。例如是他们是这个时间的人,但是是一种的人的人,也是是一种的人的人,也是是一种的人的人,也是一种的人的人,也是一种的人的人,也是一种的人的人,也是一种的人的人,也是一种人,也是一种人,也是

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Alvance FA to mear zone transfer or higher to re-

store mornal aug-mentation. Adjust F jewel on un-affected enginer to abtain desired

aircraft conditions.

THE FALSE MEE & STEEL ANALYSIS

For selmre in any position other than in zone transfer position described above. HA supportty will be mistained in an investigation to the Co. The boxst system and mechanical overtide further the superior and including direction. In selmre, up to a maximum noneignated HA position, the only effect will be the inability to obtain reverse thrust. For selmre in the Lone I supported range, the analysis of (a) above will apply except for reduction below more transfer. Faller Hart on Merch K:t applicable Same as above NR 22 543 Ħ Duct beater shutoff requires reduction to 80% My or liver. Subsequent increase is My above 80% will re-Not applicable. If duct bester initiation and fallier occurs, asse as M.V. In addition, trevere En met amiliable. As Fla reduced, eventual Zone II flameout. Zone I familier Lone I and Lameout. Zone I and Lath Is lower than neveral. Restrainfly Red Mill result for restoring Zone II augmentation before cone transfer Fla. Table Water Street initiate duct beater. the part of Sex 22 22 Not afferred Position. Duct heater cannot be shut off with normal reduction to maximus normangmented position. Normal engine total airflow increase during some transfer Read of Describe will not occur. Not applicable Sam as SATO wee transfer, lose II fuel live continues and lovers Lose I fuel flow between mortal. On subsequent FLA advance to none transfer or higher, the serval sirflow hiss signal to the total airflow reset piston will Duct heater fuel flow can-out be had off with HA until HA reduction realist in \$02.5; or lower. Sub-sepent 25; increase above \$07 will reinitiate duc-heater ruel flow. a) Seinze in SIO: Coursel system met affected not incre at Ma settleg at time of the post- tablure (Zon I - Zon II tion transfer) and higher Landing: Not applicable, If durt beater initiated and failure occurs, sabe as SLTO. In addition, car-not activate rewriser-At MA is reduced below Fuller Ellect on Schapeters Cruise: Same as 5270 Sappressor. met occer. Selaure in any post-tion other than a) Porce. â Provides sequencing of reverser-suppress.r. durt hearer initiation, and duct heater some and open and an array of a mar or the state of the name Caltited Centrel (Centimed) transfer. Pla Sequencing I

If that beater thatoff desires, reduce No with RA

Not applicable, If duct heater initiated and failure occurs, same as SLFO.

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25.2 Unitized Control

1	Feeding	Tellers Made	Fullure Effect on Subsystem	Method of Detection	Failure Effect on Engine	Feilere Effect on Aircraft	Crew Aufice Begained
Compressor falet tempera- ture sensing system (2 sen- sors remote mounted)	Senses compressor fallet temperature (TT2) with deal remote amounted sensors and willites the sense to provide Tt2 bias of various cass.						
Remote Try Sensor Gas Filled bab 25.2.3.1	Gas pressure in the bulb changes as a furer families as a fight of the families of the families of the result of the families of the families of the families and to the control as a function of Try.	Loss of charge	SLTO: The affected sensor system fails to the com- plete celd level. Control system is not affected, since the redundant Try aystem selects the higher of the two sensor systems.	An indicating flag is provided to indicate when one Ly sense system has failed.	Not affected.	ę.	
			Cruine: Sam as SLTO	Same as 5LTO	Not affected.	See 25 ATO	None
			Landing: Same as SLTO	Same as 52,70	Not affected.	Same as 31.70	×
or							
Remote Transcription of pensating bellows 25.2.3.4	Compensates for fuel temperature change effect on the motor bellows. Also provides system damping.	Loss of gas					
ŏ				e es seguir	***************************************		
Remote I ₁₂ sensor flapper lever bellous seal 25.2.3.3.	Seals servo fuel in secor bellows cavity from control drain pressure in compen- sating bellows cavity	Bellovs					
ŏ							
office	Supplies servo fuel to remote seasors	Contamination (Flugged Orifice)					
;							
Remote IT sensor (Happer valve 25.2.3.5.	Controlled by the gac filled bulb and bellow, to provide a modulated ful present signal to the control as a function of Try.	Contemination (open position)					
	ser ette menter ign p see entre menter state et estage ver	Annual to the second			Landge by: 1/ Sun	Volume Vetes The shill	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1

	Crew Action Bequired		Adjust F level outside outside outside to obtain desired aircraft conditions.	Reinitiate augmentation if additional F _m desired.	61 A 2 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	Same as \$1.70	Modulate PLA to obtain desired descent conditions.	Adjust Fn level with FLA. If caximus Fn desired, same as SITO.	Halb 2X
	Federa Effect on Aircraft		7 4	Same as above	Same as SLTO	Same as SLTO	Scoe as 5LTO	Same as SL70.	77 77
	Feilure Effect on Engine	. :		F = 25% F . Augmentation may be initiated and F increased to value above.	r 857 r.	F = 152 F . Augment.tion Same as SLTO may be 'siffated and F increased to value above.	Power schedules do not follow Same as fLTO normal Try bias as conditions change.	Some Fn change. If maximum Fn desired, same as SLTO.	" " " " " " " " " " " " " " " " " " " "
	Method of Detection		Duct nozale full open, gas generator fuel flow, duct bester fuel flow, X, Tr7, and ER lower than normal.	Same as above except duct nozzle at 4.5 square feet poaltion.	Duct rozzie ziez larger than normal. Gas generator fuel flow, duct heater, fuel flow, N2, T77, and EPP lower than normal.	Same as above except duct nozzle at 4.5 square feet position.	Same as above	Same as SLTO	
	Failure Effect on Sobsystem	SLTO: Control Tr2 system at maxicaum hot Tr2 position. Gas generator fuel flow, duct heater fuel flow, duct hostle, coopressor hiet guide wants scheduled to maximum hot Tr2 position. Duct heater fuel flow responser the virk PtA is constant at approximately cruise response rate.	Nating augmentation, duct notate acheduled to full open position. Compressor inleeds open. Compressor inlet guide vances to start-cruise position. Gas generator and duct heater fuel flows decreased.	During non-augmentation, same as above except duct nozzle scheduled to 4.5 square feet position.	Cruise: During augmentation, duct nozzle area larger than normal, gas gener- ator and duct heater iuel flows lower than normal.	During non-augmentation, same as above except duct nozzle scheduled to 4.5 square feet position.	During descent, cor- pressor bleeds open and compressor inlet guide vanes remain in start- cruise position.	Landing: Same as SLTO	
	Federe Mode		Servo (uel). Selzure (High I ₇) position)						
Unitized Control (Continued)	Function	See previous functional Contamination description. (closed position) Transmits gas filled Loss of gas charge (gas to remote sensor level loss sensor love and bulb fills with	or Tz pilot valve Modulates Tr servo 25.2.3.9 fiston as a function of Tr (resote sensor signal).	4					
Unitized	1	Remote T2 sensor flapper valve 25.2.3.5 or kmote T2 sensor motor bellows 25.2.3.2	or ZZZ pilot valve ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ			4 44			# m3

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	Crew Action Required		Adjust T level on unaffected ergines to obtain desired aircraft conditions.	Reinitiate augmentation if additional F desired.	Same as SLTO. Also, use slower than normal FLA modulation in augmentation range.	Adjust Fn level with PLA. If maximum Fn desired, same as SLTO.	None	None	None	4 cl p 3/ 24
	Feilere Effect on Aircraft		Af and CR	Same as above.	Same 25 SLT0	Same as SLTO	Not affected.	Not affected.	Not affected.	South The shift.
	Failure Effect on Engine		Fn = 705 Fmas	F - 45% F F Augmentation may be initiated and F increased to value above.	Same as SLTO except during augmentation F = 70% F = . White non-augmentation F = 10% F = 10% F mas	Some Fn reduction. If maximum Fn desired, same as SLTO.	Not affected.	Not affected.	Not affected.	Analyzed by: Videous Visites
	Method of Detection		Duct nozzle full open, gas generator fuel flow, duct heater fuel flow, N., Tg., and ETR lower than hormal.	Same as above except duct nozzle at 4.5 square feet position.	Sie 25 SL70	Same as SLTO	None	None	No ne	
7	Failure Effect on Sobsystem	Control T ₁₂ system directed to maximum cold fail safe position. Gas generator fuel flow, dutch heater fuel flow, dutch nozzle, compressor bleeds, and compressor inled guide vanes schemus cold T ₁₇ position. But heater fuel flow response rate with FLA is constant at approximately SLTO response rate.	SLTO: During augmentation, duct nozale scheduled to full open position. Gas gener- ator and duct heater fuel flow decreased.	During non-augmentation, s.e. as above except duct norzle scheduled to 4,5 square feet position.	Cruise: Same as SLTO except compressor inlet guide vanes positioned to SLTO position	Landing: Same as SLTO	SLTO: Will pass addulated pressure signal of only one sensor or an average of the two sensors depending on select position of ball valve. The control T. system vill not be affected unless a sensor failure occurs (double failure).	Cruise: Same as SLTO	Landing: Same as SLTO	
	Feilure Mode	Seizure (low T ₂) position) Bellows failure					Seizure			
Unitized Control (Continued)	Function	See previous functional description Transmits remote sen- sor modulated pressure signal force to 72 pilot valve.					Selects highest remote Tropes and and all and a sensor modulated before a signal for passage to the control Tropes and a system.			** (() () *** (
Unitize	1	Tr Pilot Valve 252.3.9 or Tr Receiver Bellows 25.2.3.8					Try Selector Valve 25.2.3.7			# #F1- 6.664 On Bed. pt vm.

Unitized Control (Continued)	(Continued)						
F0	Fonction	failere Mode	Failure Effect on Sadsystem	Method of Detection	Failure Effect on Engine	Failure Effect on Aircraft	Crew Action Baquired
Tr 2 Servo Piston 25.2.3.19	Positions various cans vithin the control as a function of Te2.	Selzure	SLTO: Ter servo piston and the Ter positioning of various came will remain in the position scheduled at time of failure. No affect for conditions existing at time of failure.	Control schedules do not follow normal Tt2 bias as conditions change.	Not affected	Not affected	None
			During cliab, control schedules do not follow normal T _C 2 bias. Gas genera- tor fuel filow higher than rormal. Dut heater fuel flow and duct rozzle area lower than rormal. Compressor inler guide wanes remain in SLTO position.	Gas generator fuel flow, N2, Tt7, EPR higher than normal. Duct heater fuel flow and duct normie area lower than normal.	Try will eventually exceed limits without crew action. Engine may surge during augmentation even if Try limits are maintained with remote EFR control.	Fventually, AF, CR.	When necessary to main- tain Tty limit, reduce to and maintain non- augmented PLA range. Adjust En level on un- affected engines to obtain desired zir- craft conditions.
			Cruise: T _{L2} servo piston and T _{L2} positioning of various cans vill reasin in the position scheduled at ties of failure. No affect for conditions existing at ties of failure.	None for conditions existing at time of failure.	Not af fected	Not affected	Mone
			During nonaugmented descent Control schedules do and ismirg at low power not follow normal Trastetings, no noticeable bias as conditions effects.	Control schedules do not follow normal Trz bias as conditions change.	Power schedules do not follow normal IT2 bias as conditions change.	Same as SLTU	Modulate FLA to obtain desired descent con- ditions.
		****	If maximum Fn desired during landing, schedules remain at high Itz value.	If maximum Fn desired, gas generator fuer flow, duct heater fuel flow, Te7, EPR, N2 lower than normal.	Maximum Fn not available. Fn = 50% Fnma.	AF and CR	If maximum Fn desired, adjust Fn level on uneffected engines to obtain desired condi- tions.
			Landing: Not affected	None	Not affected	Not affected	None
Tt2 Failure Indicator Diaphragm 25.2.3.11	Positions failure indi-Diaphragm cator detent valve in response to difference between the madulated pressure of each remote Tr2 sensor.	Diaphragm failure.	SLD: Mcdulated pressure signal to control will be the average of both sensors. The control Tr2 system will not be affected unless a sensor failure occurs (double failure).	Tr2 sense tailure indicator vill give faise Indication that one Tr2 sense system has failed.	Not af fected	Not affected	None.
			Cruise: Same as SLTO	Same as SLTO	Not affected	Not affected	None
			Landing: Same as SLTO	Same as SLTO	Not affected	Not affected	None
	······································				,		
341 41418 De 870401 044					Analyzed by: White	mine The state.	22 glate

Unitized Control (Continued)	l (Continued)			2			
#	Function	Failure Mode	Failure Effect on Salisystem	Method of Detection	Failere Effect on Engine	Failure Effect on Aircraft	Crew Action Required
Trz Failure Indicator Detent Valve 25.2.3.12	Positions and holds display flag to indicate one Tt2 sense system has failed.	a. Seizure in mid posi- tion.	SI.TO: This is the normal position indicating both Tr2 sense systems are functioning properly. In the event of a Tr2 sense system failure, the failure indicator will not be actuated. Control system on a ffected unless both Tr2 sensors fail (double failure).	None	Not affected	Not affected	None
			Cruise: Same as SLTO	None	Not affected	Not affected	None
			Landing: Same as SLTO	None	Not affected	Not affected	None
		b. Seizure in activated position	SLTO: This is a position indi- cating a failure in one Try sense system. Control sys- tem not affected unless both Try sense systems fail. (double failure).	Tr2 some failure in- dicator will give false failure indica- tion of one Tr2 sense system after correc- tion of the failed system.	Not a ffected	Not affected	None
			Cruise: Same as SLTO	Same as SLTO	Not affected	Not affected	None
			Landing: Same as SUTO	Same as SLTO	Not affected	Not afficted	None
					•		
## : : : : : : : : : : : : : : : : : :	** / 4 1 1 1 1 1 1 1 1 1				Analyzed by: Villane	16hum 110/16 The 211466	31 11 6 75 72

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Short I Unitized Control (Continued)

STEIT FAILURE MODE & EFFECT ANALYSIS

1	Fraction	Follows Mode	Feilere Effect en Sebaystem	Method of Detection	Failure Effect on Engine	Fellers Effect on Abroeft	Crew Action Bequired
Gas Generator Speed Sense System 25.2.4	Supplies N2 speed signal to gas gen- erator speed set system.						
Speed Pilot Valve 25.2.4.1	Controls praiting of speed serve platen as a function of N2 speed	a) Seinice decrease speed signal side of null)	SLTO: Schedules speed servo piston to zero speed position. Haxiaure gas generator fuel flow ratio scheduled by scro speed fallaafe plateau with translation to plateau generally in decreasing ratio direction. Gas generator fuel flow can be modulated with FLA between idle and maximum failsafe plateau value. Naximum value biased by T.D. Bleeds and inlet guide vanes scheduled by failsafe plateau. Allow plateau value biased duct heater fuel flow if our cannot initiate if off.	Ng, Ter, and EFR lower than normal. Reduction in gas generator fuel flow. Duct haster whuts off if on or cannot be initiated if c.f	r _n = 35% r _{nm}	Af and CA	Decrease to and/or maintain nonsugmented TA range. Adjust TB level on unaffected engines to obtain desired aircraft conditions.
			Cruise: Same as SLTO Landing: Same as SLTO	Same as SLTO Same as SLTO	F = 5% F mas Since as SLTO	Same as SLTO	Same as SLTO Same as SLTO
		b) Sefaure (Increase speed signal side of null)	SLTO: Schedules speed servo piston to high speed position. Gas Espensator fuel flow ratio acheduled by overspeed limiting scheduled by overspeed annihum ratio. Duct hester shuts off and engine dies. Engine may surge on rundom due to compressor bleeds remaining closed and duct nozzes at full closed position,	Buct heater flames out. Engine dies out. Engine may surge on rundown.	Engine dies out and cannot be restatted.	IFS and CR	Nove SOL to off position. Adjust in lawel on unaffected engines to obtain desired siretraft conditions.
			Cruise: Same as SLTO except engine does not die out. Duct heater shut off.	Duct heater shut off. No. Tr7. EPR and gas generator fuel flow lower than normal.	ra = -57 F rms	AF and CR	Adjust F level on unaffected engines to obtain desired air-craft conditions.
			During descent, engine dies out.	During descent, engine dies out.	During descent, engine dies out and cannot be restarted.	During descent, IFS and CR.	Same as SLTO
			Landing: Same as SLTO	Same as 51.TO	Sane as SLTO	Same as SLTO	Same as 51.TO
May tills or stores and	PF. (EEE) heaven-ings day I have come or ethics are				Analyzed by: Victure Billis	Phills The 2/10/16	6 78 40 166

Sheef ! Unitized Cortrol (Continued)

Ī	Function	Feilers Mode	Failure Effect on Subsystem	Method of Detection	Failure Effect on Engine	Failure Effect on Aircraft	Crew Action Required
Speed Servo	Controlled by speed servo to position speed set system cams as a function of N2.	d d	SLTO: Lose speed governing, start- acceleration achebole, and overspeed droop. Gas gen- erator fuel flow ratio schedule can be modulated with PLA from minimum ratio to maximum nonaugmented ratio (or acceleration ratio, whichever is lower) at speed value existing at time of failure. Acceleration fuel flow ratio value biased by Tt2.	No impediate effect. Engine dies out on normal PLA reduction to idle or alightly above idle positions.	At Try values of approximately for and higher normal maximum gas generator and augmented achedules will be maintained including Try bisa. During click engine total airflow slightly increased above normal. If die or slightly above It die desired, engine dies out on normal PA reduction. Subsequent restart may be accomplished by controlling fuel flow with slow PLA movements. In high non-wosenes in high non-augmented PLA range during restart although more than augmented PLA range during restart although more than Also, normal PLA increases from slightly above idle may result in engine aurge or exceeding turbine inlet temperature.	CR.	Modulate FLA to obtain desired conditions. If engine dies out, trastart using alow FLA increases to control starting fuel flow. Use alow FLA movements for increase power requirements in out, surge, and exceeding temperature limits.
			At Tr2 values less than approxi- mately O'F, overpeed droop will reduce gas generator to minimum fuel flow tatio achedules.	At Tt2 values less than approximately 0°F, the engine dies out.	At Tr2 values less than approximately 0°F, engine dies out.	Its values less than approximately 0'F, IFS, CR.	Move SOL to off position. Adjust Fn level on un- affected engines to obtain desired aircraft conditions. Engine can be restarted at higher Tg values.
			Cruise: Same as SLTO	Same as SLTO except FLA reduction does not result in engine die out at croise. Engine will die out on descent at approxi- mately 200°F Tc2 with low FLA positions.	Same as SLIO except PIA reduction does not result in engine det-out at cruise. Engine vill die out on descent at approximately 200°F It2 with low PIA positions.	Same as SLTO	Same as 5L70
			Landing: Same as SLTO.	Sche as 5LTO	Same as SLTO Maximum available Fn may be limited dependent upon speed existing at time of failure.	Same as SLTO Dependent on speed at time of failure, possibly AF.	Same as SLTO It maximum Fn limited and maximum Fn desired, adjust Fn level on unaffected engines to obtain desired aircraft conditions.

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Unitized Control (Continued)	(Continued)					-	
1	function	Failure Mode	Fuilure Effect on Subaystom	Method of Detection	Failure Effect on Engine	Fullers Effect on Aircraft	Cree Action Desprine
Gas Generator Speed Sit and Acceleration 15.2.5 25.2.5	Part of gas generator computing section to control gas generator speed, and acceleration to the No. 100 Med Section to the No. 100 Med Section to the first signal to acceleration fuel flow limiting is also provided to control the gas generator within safe operating limits during accelivations.			·			
		The Failure of cams, ca assumed tha system and	The Failure Mode Index Mumber for this unitized control system has been reserved in the event of future need. Parts within this system consist of cams, cam shafts, springs, and various linkages which are considered to be designed with sufficient margin to preclude their breakage. It was assumed that failure of the parts within this system will not occur. Pyllures within other unitized control systems will affect the speed set system and the total effect of such failures including the effect on the speed set system are presented in the amalysis of the appropriate system.	control system has been ges which are considered stem will not occur. F cluding the effect on th	reserved in the event of futu to be designed with sufficien silores within other unitized : Speed set system are present	ie need. Parts within this margin to preclude their control systems will affected in the enalysis of the	s system consist breakage. It was it the speed set appropriate system.
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Unitized Control (Continued)	1 (Continued)						
Į	Function	Failure Made	Failure Effect on Subsystem	Method of Detection	Fellure Effect on Engine	Fullere Effect on Aircraft	Crew Action Bagnised
Gas Generator Primary Com- bustor Pressure, Pb. Sense System 25.2.6	Provides a multiply- ing force proportional to Pb to the gas gener- ator fuel flow compu- tation system.		i				
Pb Sense Bullous 25.2.6.1. or Pb Evacuated 35.2.6.3	Transmits Pb pressure level as a force to the Pb multiplying lever. Supplies additive force proportional to force proportional to maken pressure and	Sense bellovs rupture or Evacuated bellovs leak or rupture	SLTO: Gas Generator effective Po is less than normal resulting in gas generator fuel flow less than normal Duct heater fuel flow is less than normal due to N2 reduction.	Gas Generator fuel flow, EPR, T ₂ y and N ₂ less than normal. Duct heater fuel flow less than normal.	correction in = 95% fina	AF and CR	Adjustment of remote EPR control and EPR control and companies for most of the re- duction in effective Pb.
	that by force trans- mitted to Pb multiply- ing lever is a function of Pb absolute pressure level.		Cruise: Same as SLTO	Same as \$170	F _R = 702 Fine after correction F _R = 852	Same as SLTO	Same as SITO except EPR adjustment will consensure for approximately half of the reduction in effective Pb.
. •			Landing: Same as SLTO	Same as SLTO	Reduction in Ni, Ny and fuel flow. Maximum Fn limited to SLTC conditions.	Same as 5LT0	Increase PLA on affected engine to anaintain F match with unaffected engines. Same as SLTO if maximum F desired.
P. Multipling Lever Seal Bellows, 25.2.6.3	Seals P _b bellows ablent pressure cavity from control case fuel pressure.	Leak or rupture	SLIO: Fuel leakage overboard through the P _b housing draft. Rate of fuel leak- age restricted by an orffice. P _b sense system essentially not affected by fuel pressure in ambient cavity.	Overboard drain fuel leakage from Po housing drain.	Not affected	ť	None
			Cruise: Same as SLTO	Same as SLTO	Not affected	Same as SLTO	None
			Landing: Same se SLTO	Same as \$170	Not affected	Same as SLTO	Моле
	And 1559; and/1810 and the total tot				Andread by.	14. 12. 14. 14. 14. 14. 14. 14. 14. 14. 14. 14	71:10 12

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JTF17 FALLINE MODE & EFFECT ANALYSIS

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Cree Action Begained		his system consist breakage. It was ect this system the analysis of	18 9/10/66
Feilere Effect so Airtreft		wargin to preclude their control ., stems vill affine a presented in a presented	1. 1. 1. 11. The strate
Feilure Effect on Engine		n reserved in the event of future need. Parts within this system constant of be designed with sufficient margin to preclude their breakage. It was sailures within other unitized controlstems will affect this system generator fuel flow computation system are presented in the analysis of	11/1
Method of Detection		control system has been which are considered to ystem will not occur. Fig. the effect on the gas g	+
restare theci es sessymen		The Failure bade Index Number for this unitized control system has been reserved in the event of futjure need. Parts within this system consists of a cas, springs, rollers, and various linkage; which are considered the advisor and and various linkage; and the followed that failures linking the system will affect of such failures the thin this system vill not occur. Failures within occur, and the total effect of such failures including the effect on the gas generator fuel flow computation system are presented in the analysis of the appropriate system.	**************************************
Failure Mode		The Failure Mad of a cam, spring assumed their fa and the total ethe appropriate	
Feaction	A feedback force bolance maitiplying system that comperer, and controls has generator fuel floor. Fuel floor statio, "I'P," is computed through use of the speed error signal from the speed ast and acceleration limiting maitiplied by the P, signal from the P, sense maitiplied by the P, sense maitiplied by the P, sense signal from the P, sense fuel flow. The system controls at the gas generator fuel flow. The system system by providing a signal and receiving a fuel flow feedback signal and receiving a fuel flow feedback		*** 107044 60 51115 118 2 500 COU'-6444'18 (2727 1 00
1	Cas Cenerator Fuel Flow Computation System 25.2.7	•	**** 107014 60 51111 1184 1

Pen	Fraction	Fuilere Mode	Failere Effe	Failure Effect on Subsystem	Method of Detection	Failure Effect on Engine	Failure Effect on Aircraft	Crew Action Boguired
Euch Hater Mowout Reset Piston 25.2.8.1	If duct heater airflow becomes excessive the duct nords a metivation signal to the blowout reset piston until proper duct airflow has been restored by duct nords correction when activated, the blowout reset piston signals a 25 Mg/Ps decrease to the gas decrease to the gas securated.	a) Sefaure (Nonactivat position)	SITO:	This is normal operating polition. In the event of substantial excessive duct lifting, gas generator fue treduction vill not occur during duct heater shutoff and duct nozzle area correction.	na house the same of the same	L L L L L L L L L L L L L L L L L L L	e e	In the event of substantial exc. sive duct airflow, reduce PLA to non-augmented Trage and then advance PLA to restore desired Fn level.
	computation system in order to minimize total engine mirilow increase above normal.		Cruise: Same Landing: Not fail as:	Same as SLTO Not applicable, If maximum Fn desired and failure occurs, same as SLTO	Same as SLTO Not applicable	Same as SLTO except prior to restoring augmentation Fn = 20% Fnna. Not applicable If maximum Fn desired and failure occurs, same as SLTO	Same as SLTO Not applicable	Same as SLTO Not applicable If maximum F _n desired and failure occurs, same as SLTO
	The necessity for this reset piston has not been firmly exabilished initial hardware design has provision for its incorporation. The analysis of this system is presented in the event of its incorporation and thrust levels with this reset is presented within this section only. This section also assumes	b) Seinre (activated position)	SLIO: A subside the set of the se	duct airflow condition must first occur to permit must first occur to permit this seizure position. If this dual happening occurs, the gas generator fuel flow reduction during duct heater shutoff and duct nozzle area correction the correction.	lf the dual events occur, Ny Tey FrR and gas generation fuel flow vill be lower than normal, Duct heater vill shut off during duct nozzle correction	If the dual events occur, F 401 Fma After restoring augmentation Fn - 601 Fmaa	If the dual events occur, AF and CR	If the dual events occur, reduce PLA to consultable and then reage and then advance PLA to restore augmentation. Adjust F _n level on unaffected engines to obtain desired alreraft conditions. Adjustment of remote PR control will restore most of fuel flow reduction.
	the duct blowout system is incorporated. The analysis of all other section assumes the reset provision is not incorporated.		Cruise: Same Landing: Not and sar-	Not applicable. Not applicable. If maximum Fn desired and dual events occur, sure as SLTO	Same as SLTO Not applicable e	Same as SLTO Not applicable. If maximum F ₁ desired and dual events occur, same as SLTO	Same as SLTO Not applicable	Same as SITO Not applicable. If maximum for desired and dual events occur, same as SITO.
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Cree Action Department Š. None None No immediate effect. feither Effect on Aircraft No immediate effect. No immediate effect. failere Effect en Engine No immediate effect. No immediate effect. No immediate effect. Excessive contaminant in the filter and corrective action can be controlled in most intraces by normal prifodic inspection and maintenance. Mothed of Detection Same as SLTO Same as SLIO Across the servo filter exceeds a preset level, the serva filter bypass valve opens allowing strained inter for bypass the servo filter. Containing any enter the control servo system. Dependent on the size and amount of contaminant, failures may occur in the control servo system. Failure Effect on Sadaystam Landing: Same as SLTO Cruise: Same as SLTO SLIO: Contamination protection, all fuel enter-contamination, all fuel enter-contamination from a generator deposited on yitem is passed through a 20 mesh strainer. After passing through the strainer, acroo fuel is passed through a 40 microal wash type of the fuel is forceased past the servo filter. The winceful of the fuel is forceased concamination the fuel is forceased filter. A relieving bypass valve is provided for the servo filter. Failure Made Unitized Control (Continued) Gas Generator Fuel Inlet Filter 25.2.9 Į

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	Crew Action Enquired		More SOI to off position. Adjust if deed on un- affected engines to obtain desired air- craft conditions.	Adjust Fy level on unaffected engines to obtain desired aircraft conditions.	Same as SLTO	Same as SLTO	Move SOI to off position. Adjust FN level on un- affected engines to obtain desired air- craft conditions.	Same as SLIS	Same as 51T0	 72 9 12 W.
	Federa Effect on Aircraft		1FS and CR	Ar and CR	Same as SLTO	Same as SL70	1FS and CR	Same as SLTO	Same as SLTO	L. Vills The Mindell
	failure thect on tagine		Engine dies out	During augmentation FM = 402 Fram	On descent engine will die	Same as SLTO	M, My, TIT, EFR and gas generator fuel flow increase. Crew action is required.	Same as SLTO	Same as 51.TO	Analyzed by: William
	Method of Detection		Decrease in gas generator fuel flow to minimum flow. Engine dies out.	M2. Try, EFR lower than normal. Gas generator fuel flow at minimum value.	die out.	Same as SLTO	M2, Try, EPR and gas generator fuel flow increase	Same as SLTO	Same as SLTO	
	Foilure Effect on Subsystem		SLTO: The gas generator throttle valve is scheduled to minimum fuel flow position.	Cruise: Sam: as SLTO in addition, duct nozzle to wide open position during augmentation during augmentation and to 4,5 square for the total open and to 4,5 square for the	augmentation.	Landing: Same as SLTO	SITO: Gas generator fuel flow is scheduled to maximum fuel flow position.	Cruise: Same as SLTO	Landing: Same as SLTO	
	Follows Mode		A) Seizure in decrease metered fuel flow side of nuil.				b) Seizure in interessed metered fuel flow side of null.			
(Continued)	Foreties	Cas generator fuel flow metering system. The fuel flow computation system controls the positioning of the throttle value and the throttle value pressure regulating system controls the fuel differential pressure across the throttle value so that throttle value so that throttle value so that throttle value so that throttle value metered fuel flow function is a direct matered fuel	Positions the throttle valve by modulating throttle valve servo pressure in response to the fuel flow deams signal from the fuel flow computation system.							00 (1811 m.), transce des 0 m.), trat de pince vec
Unitized Control (Continued)	Į	Gas Generator Throttle Valve System 25.2.10.	Gas Generator Throttle Valve Pilot Valve 25.2.10.1		***					 4 Mil. 1116 04 PFLO 104

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JTF17 FAILURE MODE & EFFECT ANALYSIS

Sheet 1			JIFT FAILURE MODE & EFFECT ANALYSIS	& EFFECT ANALYSIS	e [*]		
Unitized Control (Continued)	(Continued)	Fallers Mode	Fuilere Effect on Sobsystem	Method of Detection	Fullure Effect on Engine	Failers Effect on Aircraft	Crw Action Required
Gas Generator	Cas generator fuel	Seizure	SLTO: Gas generator fuel flow	No immediate effect	No immediate effect	No immediate effect	
25.2.10.2			at time of failure.	On climb after SITO, gas generator fuel flow will remain constant instead of following normal scheduling. FPR, Try and Ny will constantly increase above normal as altitude is increased.	EPR, N., N2, and Try will constantly increase above normal as altitude is increased.	CR	when occessary to prevent exceeding engine limits, move SOL to off position. Adjust Fy level on unaffected engines to obtain desired aircraft conditions.
			Cruise: Same as SLTO	Mone until power schedule is changed. Dependent on the set-ting at till a of failure, the power schedule change results in the following	No immediate effect If failure occurs at extremely low fuel flow, engine any die out on descent.	No immediate effect If engine dies on descent. IFS	Mone If engine dies on descent, same as SITO :limb.
				A power schedule change requiring a lower fuel flow than the fuel flow at time of failure results in EPR, Try, and Ny higher than normal.	EPR, N1, N2 and Try will increase above normal. Assumt of deviation from normal dependent upon amount of fuel flow error at the selected setting.	Same as SLTO climb	Same 4: SLTO climb
				A power schedule change requiring a higher fuel flow at time of failure results in IEEE, TTY, and N2 lower than normal. Duct heater may be shut off if N2 decreases by an appreciable amount due to fuel flow being too low for conditions.	EPR, N1, N2, and Try will decrease below normal. Amount of deviation from normal atgrendent upon amoun. If foel flow error at the selected setting.	AF.	Adjust Fy level on unaffected engines to obtain desired aircraft conditions.
			Landing: Same as Cruise	Same as Cruise	Same as Cruise	Same as Cruise	Same as Gruise
m)-: 11410 04 890	Principle which principles for it while title do what it was				Anadyred by: Victorian 2/2/14	9/4/14 72- 3/14/16 DATE NEUMBUT DATE	28 9/10/66

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Cree Action Beguined

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Adjust remote EPR control to correct for gas generator fuel flow increase. Adjust remote ER control to correct for gas generator facilities decrease. for gas generator fuel flow increase. If maximum En desired, same as SLIO, Same as SLTO Halen The High Fuilere Effect on Aircraft Same as SLIO Same as SLIO AF and CR Ħ Fushere Effect on Engine Andred by F * 105% F F. - 105' F. Fn = 951 Fresh Same as SLTO Approximately 51 in-crease in gas generated fuel flow. N2, I₇, and if Righer than normal. decrease in gas generator foel flow. N2, T_L7, and ER lower than normal. Same as SLIO except throttleSame as SLIO, except valve differential pressure approximately 8; increased approximately 17% increase in gas generated proximately 8 tincrease in metered fuel flow, Method of Detection Appreximately 5% Same as SLTO integral pictom at full crassure regulating valve full crasse in through valve full crease in through pressure.

Inferential pressure.

Inferential pressure.

Inferential pressure regulation vill be naintained by the proportional pressure regulating valve at level approximately 10;

Infine than normal. Approximate 5 than sormal. Approximately 10;

Infine than normal. Approximate 5 than the set of the set integral piston at full authority position for decrease in throit; walve differential pressure. In throit easter differential pressure regulation will be abundantly between the propertional pressure regulating valve at a level approximately if decrease in sected fuel flow. Fuilere Effect en Salaystern Ĺ Landing: Same as SUTO sefaure in high full sutbority mate position for increase in Cruise: Sa ST 10: 57 TG seizure in position from mili to increase ticottle valve differential pressure. Sensor seizure in position from sull to Piston setarte in full author ity position for decrease in throttle value dif-ferential pressure. waln. differential valve dif-ferential pressure. Fabre Bat pressure. decrease throttle throttle Piston **a** improved regulation by minimizing spring rate effect on pressure regulating valve position. Regulates throttle valve differential pressure to a contant value so that throttle valve position is progetional to metered fuel flow. Modulates pressure a regulating valve integral piston precuestive in response to seesed throttle valve differential pressure. Provides integral regulation to pressure regulating valve spring for Unitized Control (Continoed) Regulating Valve Integral Piston 25.2.11.2 Pressure Regulating Valve Sensor 25.2.11.1 ------Gas Generator Throttle Valve Regulating System 25.2.11 Į Pressure Pressure

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Engine conditions any be asintained by decreasing gass penerator fuel flow with the EM control.

If engine limite among the reduce to and/or maintain notangered FA range. Adjust Fn level on watered engines to obtain desired sireraft conditions. Engine pover may be increased by adjust-ment of remote EPR control and FLA. Increase FLA to correct for gas greerator fuel flow decrease. if maximum F, derired, same as SLTO. Con Action Parish 75 9 13 165 Same at 51.TO Same as 52.773 Same as SLTO Failers Elfact on Aircraft No immediate effect. Same as MITO Same as 52.70 Same as SLTO Same as 52.70 AF and CR Valence Seells ర Gas generator fuel flow, Ni. C Ny, and EPR higher than normal with the account of floresase dependent on the amount of change from con-ditions existing at time of Gas generator fuel flor, Ni, N, and ER lower than normal with the amount of decrease dependent on the amount of change from conditions existing at time of failure. Essentially not affected. Fullere Effect on Engine No immediate effect. Same as SLTO Same as SLTD Same as St.TO Gas generator fuel 100, N2, and EPR N N Higher than normal n vith increase dependent i on the amount of existing at time of failure. Gas generator fuel flow, N2, Tr7, and EFR lower than sormal with reduction dependent on the ascure of change from con-Approximately 22 decrease in gas generator fuel flow. Gas generator fuel flow may tend to fluctuate. dirions existing at time of failure, Method of Detection Saze 15 SUTO Same as SLTO Same as SLTO Cruise: Sace as SLD except
throttle valve differential pressure decreased as
approximately JL. Approximately ZL derrase in
metered fuel flow. During
descent fuel flow error
vill increase and approach Scheduled throttle valve increased fuel flow position-fig., and/or Ny decrease will result in gas generator fuel flow being less than porraal with the amount of decrease dependent on the amount of change from conficients existing at time of failure. Scheduled throttle valve, decreased fuel flow positioning and/or Ny increase 19 vill result in gas genervill result in gas generthan normal vich the assount
of increase dependent on the
dittions existing at time of
failure. resains essentially un-changed at time of failure although it may tend to iluctuate. As conditions change from those at time of failure, effect will be as follows: SLTO: Gas generator fuel flow Feilers Effect on Sobeysten Landing: Same as SLTO Landing: Same as SLTO Cruise: Same as SLTO Faller Bei-Setzure Regulates throttle valve differential pressore by hypersing gas generator inlet fuel first to gas generant pump inter-Unitized Control (Continued) stage. Fresbure Regulating Valve 25.2.11.3 Į

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1	Feeclies	Talen Mis	Feillere Effect en Soboystem	Method of Detection	Fullure Effect on Engine	feature Effect on Aircraft	Gra Active Bepaired
Pressure Regulating Valve Metered Tessure Signal Damping Orifice 25.2.11.4	Danjens extered pres- sure signal for gas generator fuel flow stability.	Orifice plugs.	SITO: Fuel pressure on metered Gas generator fuel flow wil signal side of pressure will tred to oscillate tred to oscillate approxition and approximately 2.33 antely 2.34 from normal. to follow integral piston from normal. No and Ni, No, and EPR will tend modulated pressure. Throttle EPR will tend to collate approximately 2.44 in the collations of the collate approximately 2.45 from normal. Gas generator fuel five will tend to collate approximately 2.55 from normal.	Gas generator fiel flow Gas generally to oscillate tend to approximately ± 37. mately ± 100 more to obtain the first of follow to follow to follow feel flow cacillations. lations.		ಶ	After 21D, if oscillations are objectionable, reduction of RA below auximan non- augmented vill rinhuize the augul- tude of the oscil- lations.
	*******************************		Cruise: Same as SLTO Landing: Same as SLTO	Spec as SLTC Same as SLTC	Same 45 51.70 Same 45 51.70	Same as SLT0 Same as SLT0	Same as 51.70 Same as 51.70
Windmill Orifice 25.2.11.6	Provide restriction for throttle valve metered fuel flow	Orifice plugs.	SLTO: Not applicable. This flow path not utilized during norzal engine operation.	Sot applicable.	Sot applicable.	Set applicable.	Note
or Windaill Geck 25.2.11.5	ported to case during windaill operation (IFS) One way check valve to Seizure perair throttle valve retered fuel flow to case during windaill operation only (IFS).	Sei aure	In the event of positioning During vindaill op the SOL to the off position arion at high TL2 (IF5), flow park for throttle walves, engine cil walve meter, furl to case temperature vill sta blooked. The pressure increase. repulsting walre vill closed. Cas generator full closed. Cas generator full closed. increase remalting in gas generator fuel purp relief valve opening.	During winduill oper- sice at high T ₂ values, engine cil temperature vill increase.	buring winds. Il operation at high Tr. values, engine oil temperature will incruse and say exceed limits due to gas generator fuel flow for all cooling reduct. Io only serve flow.	8	buring windull! operation, sowicor engine cil tea- perature. If necessary to sain- tain engine cil terperature linite, reduce airraft to saksomic non- ditiona.
	w fee square		Cruise: Same as SLTO	Same as SLTO	Same as SLT0	Same as 92.70	Same as SLTO
			Landing: Same as SLPO	Same as \$1.70	OT DE 28 SQ TO	EL 57	ΩΤΣ ** ΣΕΙΣ
11110 00	26 (25 T 1011) Tr 48 28 T 11 1 (11 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1				01/2		

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JIFI7 FALURE MODE & EFFECT ANALYSIS

1			Fullere Effect on Subsystem	Method of Detection	Federe Office on Engine	Federa Effect on Aircraft	Cree Action Empired
Cas Generator Minima Pressed and Southin		ă.	RIVE Gas generator firel system essentially unchanged for coeditions existing at time of fallows. Condition changes will result in the following:	% twediate effect.	So irreclate effect.	% imediate effect	Kenge
	fenerale fat five service feel five service by the Still service of the		Scouled gas generated field than reduction from that emissing at the of aniser will result in the contract field system pressure lover than nermal. If field flow is decreased asterman and falling, has have also undering of pas percented field for that at the of falling, has have also undering of pas percented field five, Ny, and doct notice.		If gas generator for flow demand is decreased sov- standially from that at the of failure, up have slow varieting of gas generator for flow, Ny, Ny, ER, and duct motife.	E	If under occurs, increase us generator feel flow if possible to reduce the slow under.
		ar e	Secure 39, permitted for that entitles of familiar at the of familiar at the of familiar at the of familiar that is set in fact flow is foreased whitestilly from that at time of failure fact at the of familiar facts to the generator fact may pressure relief allow pressure relief allow pressure relief	f. N. dennel is. inversed wheten- inally from that at the of fallere, pay processor feel flow any by Halted to less than desired. No. Tr., and EM will then also be less than desired.	il gas generator resi il.v. demad is increased sub- stantially from that at time of failure, gas senerator fuel flow, M. N. Tey. ETR may be 11 vited to less than desired.	Ch and postably AF	maiffected enforces on maiffected estimes to obtain destred aircrack conditions.
		Cr	Critical Same as SLIV	Same as 20.70	Same as MITO	Same 25 SL70	Same as S.D.
		J	Labitate Same as SLTO	54 A A A A A A A A A A A A A A A A A A A	54 yr. 48 SIV	E V	Sec. 15 4.18
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Unitized Overrol (Continued)

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ומונונים מכנונו (ממונומים	(משוניות מים)						
1	Feechies	Talen Made	Feilere Effect on Sologystem	Method of Detection	Feature Effect on Engine	Federe Effect on Aircraft	Cree Action Begained
Engine Total Airflev Cospetin System 25.2.13	Engine total airflow is controlled by con- paring actual dut air- flow to desired dut airflow calculated from actual gas gener- ator conditions, to provide a signal to the duct airflow schedule system.	and the second s					
Sensed Buct Airflow Servo Airflow Servo 25.2.13.4 or Proportional Valve 25.2.13.6	Positions seesed decit air friew serve pisted in response freque senared doct airflow compating linkage. Provides intediate transmitted to the airflow acheduled system a portion of the signal proportional to the difference belower desired and	Sciente in duct airflow state of mult. Sciente in low sensed duct airflow duct airflow state of mult.	SLID: Sensed duct airflow end of comparative lichage main- tained at low sensed duct airflow position. Signal to the duct airflow schedule system to increase duct airflow. Duct morrals and a langue than power and at all augmented PA positions and at nonaugmented PA positions and at nonaugmented PA positions is essentially at 4.5 square feet. At manimum augmentation the duct nozzle is wide open.	Engine total airflow higher than normal. - Duter normal are are an larger than normal and will be wide open at maximum augmentation.	- 00 - 01 - 01 - 01 - 01 - 01 - 01 - 01	£1	Adjust Falewel on madfected ergices to chtain desired aircraft croditions.
	sensed duct airflow. Also controls the posi- tioning of the integral system.	on the section of	Cruise: Same as SLTO Landing: Not affected. If maximum F _n desired, same as SLTO.	Some as SLTO	Fn = 852 Fara. Ne affected. If naximus Fn desired, same as 9270.	Sare asTr. Sot affected	Some ats SLTO Scot. If maximum In desirred, same ats SLTO.
Assembly 25.2.13.2 cr cr Seased Duct Air- flice Serve Pilot 25.2.13.4	Provides sensed P.J. absclute pressure signal to the sensed dust airflow com- puting linkage. See previous descip- tion.	Loss of dampening fulled into eracuated charber. Seizure in high sensed duct a inflow side of mill.	S.10: Sensed duct airflow end of comparative linkage main-tailed with high sensed duct airflow position. Signal to the duct airflow schedule system to decrease duct airflow. Duct moralle area smaller than normal at all augmented PA positions and full closed at monaugmented PA positions.	Engine surge at all augmented levels above minima augmentation.	Engine surge at all ang- mented levels above rinima- angewration. After correc- tion and at maximan non- angemented: En = 631 Enna.	AF and Cf.	Reduce to and/or maintain assemperated flat range, Adjust En fered on mainfected engines to obtain desired aircraft conditions.
Propertional Falve 25.2.13.6	See previous descrip- tion.	Science in Cruise: Shigh sensed duct airflice side of mill. Landing:	Cruise: Same & A.10 Landing: Same as A.10	Same as SLTO Butt nozzle area to full closed.	Same as SLO except: Fa = 20f Fare. Not affected. If maximus Fa	Same as APO Sor affected	Kroe. If navinur f.n. desired, same as gro.
	**				11/2 - All 11/2	1000	7101/2 26

《时间的程义等的现象》(结婚经济等的,以该是对于一种处理的影响等性,不由最终的变形,是是不是为人的生活的性情的经历影响 舞戏舞

JIFTY FALME MODE & EFFECT ANALYSIS

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Caltined Central (Continued)	(Getined)	1					
£	Function		Federa Effect on Soboyston	Method of Detection	Federe Effect so Layers	Federa Sheet on Aurora	Cree Action Bequired
Pty-Pty Diaptragn and Selling Associate 25,21,311	Provides sensed P13-P23 signal to the sensed duct airflow corputing linkage.	Loss of Carrening fluid into Pro or Page Cartings.	SLIO: Less dapping of Pry-23 diapings and believe assembly and Pri believe assembly.	ži Ž	Not affected. This failure results in shortening the life of the P _{1,2} of the phrage and bellows assembly and the P _{1,2} bellows assembly	Sot affected	, so
To leave the	Tenanting Commun.	loss of	Cruise: Sam as SLTO	X-rae	Same as 52.70	Not affected	X-OR
Mater Bellows Mater Bellows Mater Bellows Material Material Control of the Material Control of t	sater for dampoint fluid sections of PtyPs disphrage and bellows assembly assembly assembly assembly assembly	dangeoing fluid into Pri cavity.	Landing: Sare as SLW	Note	Size 45 Si 20	Not affected	aco.
Pgy Bellous Assembly 25.2.13.2	See previous descrip-	Loss of dampening fluid into		and and the second an			
Sensed Door Artiflow Servo Piston 13-2-13-5	Provides sensed duct attilou position signal to the comparative linkage.	Sizere	S.IO: The sensed duct airflow end of computative linkage will be nainfained in a fixed position. As conditions charge the desired duct airflow end of the computative linkage will be repositioned resuiting in the following:				
			As desired duct airflow increases, the signal to the duct airflow schedule system requests an increase in duct airflow, Buct normal at all augmented HA position, and augmented position as essentially at 4.5 spart feet. At national augmentation the duct notate is wide open.	Engine total airflow higher than mernal. But merzle area larger than mernal and will be wide open at maximan augmenta- tion.	Fn × 907 Fran.	ሀ	Adjust Fn level on un- affected engines to obtain desired air- craft censitions.
			As desired duct airfilou de- creases the signal to the duct airfilous schedule system responsits a decrease in duct airfilot. Duct merale area is smaller than merale area is smaller than merale and at augmented RA positions and full clead at measuremented ITA conditions.	Engice surpe at all augmented levels above minima augmentation.	Engine surpe at all agrammented levels above mislams augmented and at maxima monasquented: Fig. 652 Fran.	for the form of th	Reduce to and/or main- tain memagented FLA range. Adjust F. level on unaffected engines to obtain desired air- craft conditions.
Al. 1.112 to project two	the child manus provinces of the course of special value				Andread by Chicago Paris	Diff Milwish Diff	39/c3/65

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Unitized Control (Continued)	(Continued)						
£	Perction	Tailore Hode	Fealure Effect on Subsystem	Method of Detection	Feilere Effect on Engine	Feilere Effect on Aircreft	Crew Action Bequived
Sensed Duct Airflow Serve Piston 25.2.13.5 (Continued)			Craise: Same as A.W	Size 25 SL70	Same as SLIO except for nozzle area increase: Fn 85% Fran. For nozzle area decrease: Fn 20% Fran.	Same as SLT0	Sine as SLTO
			Landing: Same as SLW	None for increased nozzle area.	Not affected	Not affected	None
				For decreased nozzle area, duct nozzle to full closed.	Not a. fected. If maximum Fn desired, same as SLIO.	Not affected	None. If maximum Fn desired, same as SLTO.
25.2.13.7	Provides integral transmittal to the affiles schedule system of the signaled difference between desired and sensed duct airfles until this difference is reduced to zero.	z z z	SLTO: No immediate effect while conditions remain essentially the same as those at time of failure. As conditions change desiring a change in affilou, only the proportional portion of the signaled difference between desired and senses duct airflow will be transcribedle system.	and the second s	No immediate effect.	No izmediate effect.	None To a contract of the cont
			For signaled difference re- questing a decrease in air- flow, the doct mostle area will be larger than arraal with amount dependent on selved position of piston relative to mornal integrated position for mor conditions.	Engine total sirflow higher than normal. Duct notale area larger than normal.	Same F _n reduction with F _n loss dependent upon seized position of platton relative to horzal integrated position for new conditions.	CR and presibly AF.	If necessary, adjust F. livel on unaffected engines to obtain desired sirreaft crodi-
			For signaled difference re- questing as increase in sir- flue, the duct mossile area will be smaller than permit with amount dependent on seized position of piston relative to new conditions,	Engine total airflow lover than normal. Duct normal is smaller than normal. Magine may surge at some conditions.	Engine may marge at some conditions dependent whom seized position of piston relative to sortmal the tegrated position for new conditions.	CR and possibly AF	If engine surges, reduce to and/or maintain non- augmented Hr ange. Adjust En level on un- affected engines to obtain desired aircraft conditions.
·* ·*			Craise: Same 45 SLTO	Same as 51.70	Same as 54.70	Same as SLTU	Same as SLTO
The second secon			Landing: Same 45 SLTO	Same 48 SLT0	Not affected, If maximus En desired, same as S.TO.	Not affected	Noce. If maximum Fr desired, same as SLFO.
		though and manners and action assumption					
	*******************************				handyood by: When Sinks	Diff Relibert nin	12 12 6/12 K

Unitized Control (Continued)	octinued)			n.			
1	Faction	Taller Make	Fullere Effect on Solisystem	Method of Detection	Failure Effect on Engine	Feilers Offect on Aircraft	Crew Action Depaired
Duct Airflow Schedule System 25.2.14	Schedules duct air- ilow as signaled by the difference between desired and sensed duct airflow from the eggine total airflow competing system, and by augmentation level from the duct heater scheduling and fuel flow computation system.	,					
Area Control Valve Flapper Valve 25.2.14.1	Modulates area control valve servo pressure to control duct air- flow by duct notale	Contaminant, valve Jails in open position.		Engine total airflow higher than normal duct notale area to wide open position.	Fn - 901 Fnm.	£ 24	Adjust Falerel on unaffected engines to obtain desired afreraft conditions.
	area positioning.		Proise: Same as SLTO	Same as SLTO	Fn - 85% Fame	Same as SLTO	Same as SLTO
ö			Landing: Same as SLTO	Same as SLTO	Not affected. If maximum In desired, same as SLTO.	Not affected	Sone. If maximus for desirred, same as SLIV.
Area Control Valve Modulated Pressure Supply Offlice 25.2.14.2	Persits modulation of E area control valve serio pressure.	Plugged					
Velve 25.2.14.3	Positions duct notale area to control duct airflow.	Seizure in Increase duct area side of mull.					
7 8 L 1244 De 872 4 184	PRINCES OF THE PRINCE	-			Amelyzed by: ///	Mail The Street	2 1/2 Males

JTF17 FALLERE MODE & EFFECT ANALYSIS

atrol r Valve		Feilers Mode	Failure Effect on Soboystem	Method of Detection	failere Effect on Ingine	Feilere Effect on Aircraft	Grew Actions Bequired
 -	See previous description	C aminant, varve fails in closed position.	SLTO: Duct mozzle scheduled to full closed position.	Engine surge at all augmented levels above minimum augmentation. Duct nozzle to full closed position.	Engine surge at all augmented levels above minimm augmentation. After correction and at maximum nonaugmented Fn = 65% Fma.	A b	Reduce to and maintain nonaugented PlA range. Adjust F _n lewel on unaffected engines to obtain desired aircraft conditions.
Area Control Valve	See provious description	Seizure in decrease duct	Cruise: Same as SLIO	Same as SLTO	Same as SLTO except Fn = 20% Finna.	Same as SLTO	Same as SLTG
			Landing: Same as SLIO	Duct Nozzle to full closed position.	Not affected If maximum Fn desired, same as SLTO	Not affected	None If maximum Fn desired, same as SUTO.
Area Control Valve Ergulated Pressure Derping Orifice 25.2.14.4	Dempens regulated Pl pressure to high pressure side of area control valve.	7 108 20 20 20 20 20 20 20 20 20 20 20 20 20					
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the first duct notice for a marking of withdraw fractions for a marking for a marking of withdraw for a marking for a marking of withdraw for a marking of withdraw for a marking for	Sheer I	:		JIFI/ FALLME MUDIE & EFFECT ANALTSES	& EFFECT ANALTSIS			
State Stat	ized Control	(Continued)	Failure Mode	Fuilure Effect on Subsystem	Merhod of Detection	Foilers Effect on Engine	Failure Effect on Aircraft	Crew Action Bequired
sugmented FLA range below At nonaugmented PLA approximately 90%, 3, the range below approximately 90%, 3, the range below approximately 90%, 3, the range below approximately 90%, 3, the duct notate area will be somewhat larger than normal argumentation same as SLTO Seizure in SLTO: Not applicable for limiting condition. Induct heater shutoff and Duct normal on substrate lover than normal	NIM Area .15.1	Limits duct nozzle area to a maximum of		!	None	Not affected	Not affected	None
Landing: Same as SLTO Seizure in SLTO: Not applicable for limiting condition. Initial augmentation condition. condition. if duct heater shutoff and than normal on substrain lower than normal on subsequent augmentation. aubsequent augmentation. Cruise: Same as SLTO Landing: Not affected I maximum Fn desired, same as SLTO same as SLTO Landing: Not affected if maximum Fn desired, same as SLTO same as SLTO Landing: Not affected if maximum Fn desired, same as SLTO same as SLTO Landing: Not affected if maximum Fn desired, same as SLTO same as SLTO None Same as SLTO None		ditions. The stop is activated to either its limiting position or withdrawn as a function of Zone I manifold tuel level		augreited PLA range below approximately 90% N2, the duct nozzle area will be somewhat larger than norsal.		En will be somewhat lower than normal	5	Adjust F, level on affected engine to obtain desired aircraft conditions.
Landing: Same as SLIO SITO: Not applicable for not applicable for initial augmentation condition. If duct heater shutoff and than normal on subsequent augmentation. Subsequent augmentation. Engine may surge during augmentation. Cruise: Same as SLIO Landing: Not affected if maximum Fn desired, same as SLIO Landing: Not affected same as SLIO Landing: Not affected if maximum Fn desired, same as SLIO Same as SLIO Landing: Not affected if maximum fn desired, same as SLIO Same as SLIO Landing: Not affected in the same as SLIO		and ignition valve position.			Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO
condition. If duct heater shutoff and failure occurs, duct nozzle area lover failure occurs, duct nozzle than normal on subsequent augmentation. Engine may surge during augmentation. Cruise: Same as SLTO Landing: Not affected limixians Fn desired, same as SLTO Landing: Not affected same as SLTO Landing: Not affected same as SLTO Same as SLTO Same as SLTO Landing: Not affected same as SLTO Landing: Not affected same as SLTO Landing: Not affected same as SLTO Same as SLTO			Seizure in	24	Not applicable	Not applicable	Not applicable	None
Same as SLTO Not affected None If maximum Fn desired, same as SLTO duct heater shutoff.	·		position	condition. If duct heater shutoff and failure occurs, duct nozzle area lover than normal on subsequent augmentation.		Engine may surge during aug- mentation. If engine surge occurs, miter correction and at maximum nonaugmented at 5% F.m.a.	AF and CR	If engine surges during augmentation, reduce to and/or maintain non-augmented PL range. Adjust fn level on unaffected engines to obtain desired aircraft conditions.
Not affected None If maximum Fn desired, same as SLTO duct heater shutoff.			و مرود سالة واللامن و		Same as SLTO	Same as SLTO except Fn = 20% Fama	Same as SLTO	Same as SLTO
					None	Not affected If maximum F _m desired, same as SLTO duct heater shutoif,	Not affected	None If maxicum Fn desired, same as SIO duct heater shutoff.
	·					·		

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Sheef 1 Unitized Control (Continued)

Failure Effect on Aircreft Crew Action Bagained	×	Adjust Fn level on unaffected engines to obtain desired aircraft conditions.	minutes a regional	O Same as SLTO O None. If maximum F _n desired, same as SLTO		
Failure Effec	Not affected	AF and CR		Same as SLTO Not affected		
failure Effect on Engine	Not affected	Fn = 957 Frms		Fn = 85% Frame Not affected. If maximum Fn desired, same as SLTO		
Method of Detection	None	Nozzle to wide open position.		Same as SLTO		
Failure Effect on Subsystem	Not affected unless the duct nozzle feedback signal is lost.	SLTO: In the event the duct nozzle Nozzle to wide open feedback signal is lost position. (double failure), there is no signal to the duct heater blowout valve to shut off the duct heater if on,	or prevent initiation if off. For this failure condition, the loss of duct nozzle feedback results in the duct nozzle golng to vide open position.	Cruise: Same as SLTO Landing: Not affected. If maximum Fn desired, same as SLTO		
Failure Mode	Seizure in non shut-off	position	U	ų	**	
Continued)	Provides signal to duct heater blowout	valve to shut off duct heater in the event that duct nozzle feedback signal is lost.	The necessity for the duct heater blowout system has not been firmly established. The use of the duct nozzie feedback fallaste	valve is directly related to the use of the duct heater blowout system. Initial hard- uare design has provision for incorporation of	, L	porated.
Unitized Control (Continued)	Duct Nozzle Feed- back Failsafe	Valve 25.2.16.1				

Unitized Control (Continued)

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1	Function	Feilure Mode	Federa titlent on Sebsystem	Merchant of Dentering	Personal Country of Continue	Personal ETTOCT OR AMCOUNT	
Duct Heater Blosout System 25.2.17	Shuta off the duct heater in the event of loss of duct nozzle event of substantial excessive duct airflow.	a) Science of piston or valve in position to permit duct heater operation of signal orifice orifice orifice orifice	SLTO: In the event of substantial excessive duct airflow, the duct hearer will not be shut off if on or can be initiated if off. The highest excessive duct airflow condition is for a nozate could be caused by the loss of the duct nozale feedback.	For duct nozzle vide open failure, The duct heater is not duct heater is not can be initiated if off.	Fn = 90% Frank	Af and CR.	Adjust Falevel on unaffected ergines to obtain desired airtraft conditions.
Consisting of Duct Heater Blowout	The necessity for the duct heater blowout system has not hear final established		Cruise: Same as SLTO Landing: Not afferted. If maximum Fn desired, same as SLTO	Same as SLTO Same as SLTO	Fn = 85% Frama. Not affected. If maximum Fn desired, same	Same as SLTO Not affected	Same as SITO None. If maximum Fn desired, same as SLTO
and Duct Keater Blowout Valve Piston 25.2.17.2 25.2.17.3		b) Seizure of piston or valve in postito. to not permit duct heater operation	SLIO: For this failure to exist, a substantial excessive duct airflow condition or. loss of duct nozale feedback must first occur. If they do occur, duct hearer is shut off if on or cannot be initiated if off. The highest excessive duct airflow condition is for a duct nozale vide open failure which could be caused by the loss of the duct nozale feedback.	For duct nozzle wide open failure, the duct heater is shur off if on or cannot be initiated if off.	Fn - 402 Frank	AF and CR	Reduce to and/or maintain monaug- mented PLA range. Adjust Fn level on unaffected engines to obtain desired aircraft conditions.
	incorporated.		Cruise: Same as SLTO Landing: Not affected. If maximum Fn desired, same as SLTO	Same as SLTO	Fn = 10% Frms Not affected. If maximum Fn desired, same as SLTO	Same as SLTO Not affected	Same as SLTO None. If maximum Fn desired, same as SLTO
7 FF (148 DA 195.4)	and their section become say a section of the present of				Andred by: Villian World		35 4/0/66

Sheet I Unitized Control (Continued)

Fee	Feection	Failure Mode	Failure Effect on Salaraston	Method of Detection	failure Effect on Lagine	Failure Effect on Aircraft	Grew Action Boundard
Duct Schedule Pilot Valve and Servo System 25.2.18	Positions duct heater scheduling cam as a function of FLA.						
Duct Schedule Pilot Valve 25.2.18.1 or Duct Schedule Servo Piston	Modulates servo- pressure to duct archedute servo piston to position the servo- piston as a function of PLA. Translates duct schedule can as con-		SLIO: Duct schedule cam positioned to maximum augmentation PLA position. Duct heater fuel flow vill remain at maximum PLA schedule level when PLA reduced. T ₂ bias of duct heater schedule vill continue to function. Duct heater fuel shuroff and initiation vith PLA vill continue to function.	Duct heater fuel flow cannot be reduced with PLA.	Duct heater fuel flow Duct augmentation level can- cannot be reduced with not be reduced with PLA. PLA.	ğ	Engine can be operated at maximum augmentation or augmentation can be shut off. Adjust Fn level on unaffected engines to obtain distions.
25.2.18.2	trolled by the duct schedule pilot valve so that the schedule cam is positioned as a function of PLA.	posttion.	For duct heater shutoff, normal reduction to duct heater circulation fuel flow will continue to function for pilot valve seizure. Circulation fuel flow will be of maximum augmentor PIA leve! for servo platon seizure.	For servo piston seizure, duct heater circulation fuel flow vill be at maximum augmentation PIA level.	Not affected. System can handle this level of circulation fuel flow.	ð	None
			Cruise: Same as SLTO Fanding: Same as SLTO	Same as SLTO Same as SLTO	Same as SLTO Same as SLTO	Same as SLTO Same as SLTO	Same as SLTO Same as SLTO
Duct Schedule Pilot Valve 25.2.18.1 or Out Schedule Servo Pieron	See previous descrip-	Seizure in decrease PIA side of null position. Seizure in consumment	SLIO: Duct schedule cam positioned to circulating flow position. Duct heater fuel flow scheduled at minimum ratio at all augmented FLA positions. Duct heater fuel shut off and initiation with FLA will constant to function	Duct heater fuel flow at minimum ratio values at all ang- mented PLA positions.	Fn = 632 Fmaa	AF and CR	Adjust En level on unaffected engines to obtain desired afreraft conditions.
25.2.18.2		tation IIA position.	Cruise: Same as SLTO Landing: Not affected. If maximum F. desired, same as SLTO.	Same as SLTO Same as SLTO	Fn = 25% Frank Not affected. If maximum Fn desired, same as SLTO.	Same as SLTO Not affected.	Same as SLTO None. If maximum fn desired, same as SLTO.
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Unitized Control (Continued)	(Continued)						ž.
Hom	Fraction	Feilure Mode	Failure Effect on Subsystem	Method of Detection	fuiture Effect on Ingine	Failure Effect on Aircraft	Crew Action Depaired
Duct Schedule Servo Pisten 25.2.18.2	See previous descrip- tion	Seizure in any position be- tween minimus and maximus PLA positions.	SLTO: Duct heater fuel flow re- mains at PLA schedule existing at the of failure. To bias of duct heater schedule will continue to function. Duct heater fuel abutoff and intination with PLA will continue to function.	Duct heater fuel flou cannot be modulated with FLA.	Duct heater fuel flow cannot be modulated with FLA. Fa level will be between the two extremes previously described with level dependent on failure position.	CR If fallure occurs at low augmented FLA position, AF.	Engine can be operated at existing augmented level or augmentation can be about off. Adjust Pn level on unaffected engines to obtain desired aircraft condition.
			For duct heater shutoff, circulation flow will resain at augmented schedule existing at time of failure,	For duct heater shut- off, circulation flow will reasin at aug- mented schedule existing at time of failure and will vary with Tr2.	Not affected. System can handle level of circulation fuel flow.	ŧ	Kone
			Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO
			Landing: Not affected. If maximum Fn desired, same as SLTO.	Same 4: 5LT0	Not affected. If maximum Fn desired, same as SLTO.	Not affected	None. If maximum Fn desired, same as SLIO.
Buct Schedule Servo Bate Pilor Valve 25.2.18.3	Varies the response rate of the duct PIA fuel flow schedule as a function of T _{L2} .	Sture	SLTO: Duct FIA fuel flow schedule response rate remains at conditions existing at time of failure. There is no effect on response rate until TQ increased above approximately 200°F followed by a reduction in T _Q 2.	No immediate affect.	No immediate effect.	No ismediate effect.	Уо пе
			Cruise: Same as SLTO. Pilot valve will continue to be driven in an increasing Tr2 direction with normal response rate maintained.	No immediate effect.	No immediate effect.	No impediate effect.	None
			when Tt2 increased above approximately 2005; sub- sequent operation at Tt2 values less than highest Tt2 value encountered will result in out heater fuel flow PtA response rate being less than normal with rate dependent on highest Tt2 encountered.		When T _L 2 increased above approximately heater fuel flow PLA response 200°F, lower that at T _L 2 value encountered flow PLA response the highest T _L 2 value encountered flow PLA response rate where highest T _L 2 value has at T _L 2 values less than exceeded approximately 200°F. countered.	ť	Mone
			Landing: Not affected	Not affected	Not affected	Not affected	None
På.: 11110 de 874.01 va.e	99 C 42(2) NOTICE NOT PROPERTY OF STATE OF SPACES VALUE				Analyzed by: //diana 7/19/6	DATE MELIANISH BATE	F St. State

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JTF17 FAILURE MODE & EFFECT ANALYSIS

	Crew Action Bequired	None If engine surges, re- stard PAA to folle then advance PLA into sug- mented range only when Ny is above approxi- mately 60%.	Same as SITO If reverse desired, reduce FLA to idle and adjust reverse F _n level on unaffected engines.	N2 and speed is not	19 (1/6) 1 mm m
	Feilere Effect on Aircraft	Not affected CR If engine surges, may	Same as SLTO Same as SLTO	drive the low speed pro	White Pales The strate.
	Failure Effect on Engine	Not affected Duct heater initiation with rapid FLA movement from a low nonaugmented metting may result in engine wurge.	Sime as SLTO Not affected. Reverser- suppressor cannot be acti- vated.	ise in speed above 90% No vill if the sefaure occurs at less in with PLA is not affected.	Anadyred by: Video
	Method of Detection	None Duct heater initiation with rapid 71A aug- mentation positioning while engine at a low N2 speed.	Same as SLTO Same as SLTO. Also, reverser-suppressor cannot be actuated.	than (a) above, an increase rects will be the same. Freer-suppressor actuation	
	Fuilvre Effect on Subaystom	SLIO: This is normal position during augmentation. Speed protection authority lost. Duct heater can be initiated with PLA at any N2 speed.	Cruise: Same as SLTO Landing: Same as SLTO. Also, reverser-suppressor can- not be activated.	For seizures in any other position than (a) above, an increase is speed above 90% M ₂ will drive the low speed projection valve to the position described above and the effects will be the same. If the seizure occurs at less than approximately 90% M ₂ and speed is not increased above this value, the reverser-suppressor actualish with TA is not affected.	
	Feilers Mede	a. Seizure at or above approxi- mately 90% N2 position.		b. Seizures in any other position than (a) above.	
(Continued)	Franction	Protects against duct heater initiation below a predeteratined Ny apeed, Also protects against reverser- Against reverse			de (166), maltitudade de E miti Licies de 660-de cer
Unitized Control (Continued)	1	Low Speed Pro- tection Valve 25.2.19.1			what faces the papers one

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Unitized Control (Continued)

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Cree Action Depaired

Salbere Effect on Aircraft

Same as SLTO except

F_n = 20% Free.

Not affected. If maximus

F_n desired:

F_n = 65% Free. Failers Effect on Engine Not applicable Fn = 65% From. Cannot initiate aug-mentation. Method of Betection Not applicable Same as SLTO landing: Not affected, If maximum Fn desired, same as SLTO nonaugmented. If duct heater shut off and failure occurs, cannot reinitiate duct heater fuel flow: Feibere Effect on Subsystem SLTO: Not applicable during augmentation. Cruise: Same as SLTO f. authorized by RLA when a) Science in SLI
authorized by N2 speed duct heater
level to
a) Energise electrical
ignition igniters.
b) Provides bias to
total airflow contotal airflow conf. achialise the airflow transfest upon
Zone I initiation.
c) If SQL in "on"
position, closes
Zone I amifold
dump valve and
initiates zone manifold rapid illi. Failure Mode This system provides a limit on matered field for during filling of either have a for during filling of either hard fold until manifold until manifold tilling has been sarcomplished. Energizing of duct hearer electrical ignition is scheduled during form I manifold during form I manifold systems are scheduled for both of the manifold systems are scheduled for both of the manifold system to the total mirring intintion of the interval of the courtel system to the total mirring intintion of burning intintion of burning intintion of burning intintion of burning fold upon selected for draining of each manifold upon selected for the applicable room. Žieji. Duct Beater Fill: Sutoff, and Dusp Con-trol Valve 25.2.20.1 or Duct Heater Fill: Sutoff, and Dusp Con-trol Valve Fiston 25.2.20.2 Sequence, Fill and Dump System 25.2.20 Duct Heater Į

Reduce to and/or amintal monaugmented TA range. Adjust Fa level on to affected engires to obtain desired afrorest conditions.

None

Not applicable

AF and CR

Same as 52.70

Same as SLTO Not affected

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and the same and the article and the same of the and the same and the

Ī			ITET FALLINE MODE & EFFECT ANALYSIS	& EFFECT ANALYSIS		#	
Unitized Con	Unitized Control (Continued)						
1	Feaction	Feilers Mode	Feiler Effect on Sologistem	Method of Detection	Follore Effect on Engine	Fullere Effect on Aircraft	Crew Action Baquired
Duct Beater Fill. Shutoff.	d) Flaces the Zone II	b) Seizure in	д Б.То:	None	Not affected	Not affected	None
and Dump Con-	 .	heater on	Minimum duct heater fuel flow	Auguentation cannot	Minimus augmentation at all	ď	Use normal PLA
25.2.20.1	Zone I manifold	position.	tions in nonsugaented range.	MA or speed reduction	nented range.		schedule on
	fill sensor.		Puct heater fuel flow may be shut off only with 30L.	below 80% N2.			Adjust Fn level
00							engines to obtain
Duct Easter							desired aircraft conditions.
Fill, Shutoff,	heater fill, shutoff,		Cruine: Same as SLTO	Same as 52.70	Same as 9270	Same as SLTO	Same as SLTO
trol Valve	in response to signals		Landing: Same as SLTO. In addition,	Same 25 SL70	Same as SLTO. In addition,	Same as 51.70	Same as 51.70
Fiston 25.2.20.2 (Continued)	controlled by PLA when authorized by N ₂ speed.		annimps duct heater fuel flow during reverse operation.		ninisum sugmentation during reverse operation.		
Zone I Shutoff		a) Setzure in closed	SLTO: Not applicable during augmentation.	Not applicable	Not applicable	Not applicable	None
-7.4.40.3	signaled by duct heater fill, shutoff	position.	If duct heater shutoff and	Cannot initiate	F. = 651 F	Ar and Ca	Reduce to and for
	and dump control value which is controlled by		failure occurs, camot reinitiate duct heater fuel films.	augmentation.	Pou.	 	mented FLA range.
	of SOL and N2.						Adjust Fn level on unaffected engines to obtain desired
							aircraft condi-
			Cruise: Same as SLTO	Same 48 SLT0	Same as SLTO except Fn = 20% Fnas.	Same as SLTO	Same as SLIO
			Landing: Not affected. If maximum	None	Not affected. If maximum	Not affected	None. If marinus
					Fn desired, Fn = 55% Fnss		In desired, same as SLYO monaug- mented.
		b) Setzure in open posi-	SLTO: Not affected during duct heater operation.	None	Mr: affected during duct heater operation.	Not affected	None
			When PLA reduced to non-	Continuous fuel flow	At nonaughented FlA tange,	ď	Maintain augmented
			Augmented range, duct heater circulating fuel flow	from Zone I dump valve	continuous flow of fuel		E.A tange. Adjust
			plus intermittent rapid fill	Ma in nonguguented	overboard drain.		affected engines to
			fold with most of this fuel				obtain desired air- craft conditions.
			overboard drain.	1	1	1	
			OTTO: 27	Same as SLTO	Name as NLTO	Same 48 SLT0	Same as SLTO
			Landing: Not applicable, If maxi- mum Fn desired and seizure	Not applicable	Not applicable. If maximum Fn desired and seizure	Not applicable	None, If maximum Fn desired and selenre
			occurs, same as SLTO.		occurs, same as SLTO.		occurs, same as
							.075
					- {		1
					Analyzed by. Villany 2/14/14	PART MELABULT PART	16 35 111 Sec.

JIFT FAKINE MORE & EFFECT ANALYSIS

1	- Parities	The Ba	Palen Ellet en Sabapten	Bathal of Denotine	Feilers Offict on Engine	Feilers Effect on Abunda	Over Author Supplied
Some II Shatoff Valve 25.2.20.4		a. Selaure is closed position.	SLIO: Not applicable during aug- mentation level above zone transfer.	Kot applicable	Not applicable	for applicable	B
	with anthorization by duct beater [ill, shatoff, and dump control valve and by Zone I wanifold fill sensor valve.		If M. reduced below more transfer level or augmenta- tion abortoff and failure occurs, camont relatitate Zone II foel flow. Sub- sequent doct hanter feel flow acheduling above most transfer level will result in all dect bester feel flow ported to Zone I.	After seizure, doct heater feel flow scheduling above zone transfer level my re- malt in doct heater flow it a sproximately 13% higher than trans- fer walne.	After seiner essentially normal augmentation unin- tained up to derr hauter feel flows of approximately 23% higher than nose trans- fer level. Perfect increase in dect heater feel flow may result in dect heater hiow out. At dect heater feel flow nome transfer: F _n = 50% F _{max} .	\$1 0	If ther batter blows out, augmentation can be reinitiated. Maintin HA range at mose transfer level or lower, M- just F, level on manifected augmentate condi- tions.
			Craise: Same as NIP reduced aug- mentation. Landing: Not affetted. If maximum Fm desired, same as NIP reduced augmentation.	Same as SLTO	Sare as SITO except. F. = 802. Foun. Suc affected. If maximum F. desired, mass as SITO redeced augmentation.	Same as \$1.70 For affected	None, 1f antima familiaries for the transfer of the transfer o
		b. Seimere in cpc= posi- tion.	SLTO: Not affected during augmentation level above zone transfer.	***	Hot affected	Soc affected	ž.
			If PA reduced below some transfer level, duct heater feel four hard fill full vil alternately be ported to Zone II manifold with mest of this fuel flowing out Zone II damp walve overmored drain. At Zone I supmented At tange, Zone I fuel ported overhoard feel flow reduced when Zone II fuel ported overhoard behalf allow after shut off, will result in alow Zone I filling.	helow none transfer HA level, continuous feel flow from Zune II damp wilve overband frain. Bering Zone I suppensed FLA range, duct mozzle, duct bester feel flow, and fa will test to fluctuate. Boet baster will blow out as FLA ins reduced near min- man augmentation. After duct bester is shat off, relatization worthal.	Mormal engine operation above some transfer FLA range. Below some transfer FLA position, continuous fieel flow from Zone III dump walve overboard drain. Buring Zone I suppersistion FLA range. Fu trends to reduced to soar minimum reduced to soar m	8	Maintain PLA above some transfor posi- tion. Belaitate segmention at high PLA if doct beater Nions out. Adjust Fa level on w.— affected engines to obtain desired air- craft conditions.
			Cruise: Mornally not applicable since normal cruise con- dicton is with Zee I operation only. If Zee II operated at cruise and seinve occurs, same as SITO.	Morually not applica- ble. If netwer occurs, same as ATO.	Mormally not applicable. If seiner occurs, same as ATO.	Mormally not applica- ble. If seizure occurs, same as SLTO.	Mose. If selmre occurs, same 48 SLTO.
			Landing: Not applicable. If maximum Fn desired and selecte occurs, same as SLFO.	Kot applicable	Met applicable. If maximum Fn desired and selimit occurs, same as SITO.	Set applicable	Fone. If maximum Fn desired and seizure occurs, same as SLFO.

Sheet 1 Unitized Control (Continued)

1	Teaction	Fullers Made	Failure Effect on Subsystem	Mothed of Detection	Feilure Effect on Engine	Failure Effect on Aircraft	Crew Action Bequired
Zone II Rapid Fill Valve 25.2.20.5	Ports either gas gen- erator fuel pump inter- stage fuel for rapid		SLTO: Mot applicable at augmenta- tion above zone transfer level.	Not applicable	Mot applicable	Not applicable	Kone
¥		fue: to out-	If PLA reduced below none transfer level and seizure occurs, subsequent augmenta- tion above some transfer vall result in continuous gas	After seisure, duct beater fuel flow scheduling above soce transfer level	Zone I operation not affected AF and CR until durit heaver fuel in- creased approximately 25% above none transfer level, bytcher increase in duct	NF and CR	If duct heater bloss out, sugsentation can be reinitiated. Nain- tain FLA range at more transfer level
Zone II Nanifold Fill Sensor Valve 25.2.20.6	Senses Zone II mani- fold fuel level and provides signals to control the rapid fill valve and the Zone II	Seimre in malfold drained posi- tion.	grantity pay intended for to Zone II sanifold and all duct heater for to Zone I sanifold.		in duct heater blow out. At duct heater zone transfer: Fn = 90% Pina.		lettoric maffected engines to obtain desired aircraft conditions.
or Zone II Manifold Fill Sensor Valve Piston 25.2.20.7		Seture in munifold drained post- tion.	Also, for seizure of Zone II manifold fill seasor valve or pistor, the Zone II schedil: list value is not actuated which lists duct bester fuel flow to some transfer level. Also duct nozzle is continuouily biased for Lone II ignition anticipation position.	Buct mozzle area some- rn = 90% Fman- what larger than normal. Duct heater fuel flow can not be locreased with PLA above some 'ransfer level.	r, = 90% Frank.	Same as above	Adjust Fn level on no. Greted engines to obtain desired aircraft conditions.
			Cruise: Same as SLTO reduced sugmentation. Landing: Kot affected. If maximum F. desired. same as SLTO.	Same as SLTO reduced augmentation. 0 None	Same as SLTO reduced augmentation except: Tn = 80% Fmas. Not affected. If maximus Fn defired aase SLTO.	Same as SLTO reduced augmentation. Not affected	Same as SLTO reduced augmentation. None. If aaximms Fn desired, same as SLTO.
Zone II Rapid Fill Valve 25.2.20.5	See previous descrip- tion.	Seimre in po- sition to port duct heater metered fuel to outlet.	St.TO: No.	None After PlA reduction below zone transfer, on subsequent PlA ad-	= = =	No immediate effect. CR. If duct heater blows out, AF.	None If duct heater bloss out, augmentation can be re- initiated. Naintain FLA
Zone II Manifold Fill Sensor Valve 25.270:6 or Cone II Manifold Fill Sensor Valve Fiston 25.2.20:7	See previous descrip- tios: See previous descrip- tion:	Science in manifold tilled position. Science in manifold tilled position.	above none transfer TA post- tion. Zone I fuel reduced during Zone II fuel reduced during Zone II manifold fill sensor valve or piston seinres. The Zone II schedule limit valve reasins in the nonlimiting posttion. On TA posttioning above sone transfer level, duct heater fuel flow vill be acheduled by TA vithout normal limiting for Zone II manifold filling.	Vances above some variable transfer there will be a Fa reduction and decrease during Zone II manifold filling.	transfer there vill be Augmentation up to zone a Fn reduction and transfer level not affected. Act duct balter zone transfer: create during Zone II Fn = 90% Frma. manifold filling.		ange at some transfer level or lower. Adjust To level on maffected engines to obtain de- sired aircraft condi- tions.
mbur (4100 des manues 1	nes effere on party right 2 ton perindicities 4195 7 to				Anadyzed by:	1 Jan Poll no street	2 78 110/66

TITT FALLINE MODE & EFFECT ANALYSIS

Normally not applica- Normally not applicable, If Normally not applicable None, If selmore occurs, ble, If selmore occurs, same as SLTO. If selmore occurs, same as SLTO. same as SLTO. Naintain augmented F.A. ringe. Adjust In level on unaffected engines to obtain desired air-craft conditions. Adjust Tn level or un-affected engines to obtain desired air-craft conditions. 34 41/6 2/C Com Action Deprine Mose. If maximus Fadesired and selzure occurs, asme as SITO. Mone. If maximum Fn desired and seizure occurs, same as SLPO. Sam as 5170 803 Nome The shake No immediate effect.

No immediate effect, On clinh CR.

vith duct heater shut off,
engine oil remperature will
eventually increase and may
exceed limits. Failure Effect on Aircraft Not applicable. If maximum En Not applicable desired and sefaure occurs. ot applicable tot applicable Same as above Same as SLTO ot affected E Par Whom The Man Not applicable. If paximum In desired and seizure occurs, same as SLTO. Failure Effect on Engine Duct hwater initiation slower than normal. Analyzed by: Not applicable Fn - 70% Fres. Same as SLTO Sot affected Lover than normal Fn thrust. Essentially no change in augmentation level with FLA modula-No duct heater circu-lation fue: flow when duct heater shut off. Duct heater initia-tion slower than normal. Method of Detection Landing: Not applicable, If maximum Not applicable F_n desired and seizure occurs, same as SITO. Landing: Not applicable. If maximum Not applicable Fn desired and seizure eccuts, same as \$170. SLTO: Not applicable during initial Not applicable Same 48 SLT0 Son Son None re-aining open after rapid it lill has been completed.

Zone I fuel flow constant at approximately 5000 pph at all augmented FIA positions.

Zone II fuel flow constant at approximately 3000 pph at all approximately 3000 pph at all augmented FIA positions above renasfer. Cruiss: Nermally not applicable since normal cruise condition is with Zone I operation only. If Zone II operated at cruise and seizure occurs, same as when duct heater shut off, have no duct heater cir-cul ting the flow. Duct heater fuel pressure in-crosses to maximum capability of cuct heater fuel pump. Duct heater initiation after se cure will result in cir-culation flow path to gas On reinitiation of duct heater, Zone I filling will be slower than normal. generator pump interstage Not affected during duct Failure Effect on Subsystem heater off conditions. A.W: N. imediate effect. Croise: Same as SLTO augnentation. Seizure in S circulation, position. Seizure in S en position. Failure Made i As signaled by Zone I anamatelic fill senact, ports gas generator purp interstage fuel to Zone I manifold for rapid fill during duct heater intelation and ports duct heater circulating fuel to gas generator perping duct heater off operation. Unitized Control (Continued) Lone II Manifold Fill Sensor Circulation Flow Zone II Manifold Fill Sensor Zone II Rapid Fill Valve 25.2.20.5 Valve Piston (Continued) 25.2.20.6 23.2.20.7 25.2.20.8 ij 1.1 ...

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Cruise: Same as SLTO Landing: Not affected. If maximan Fn decired, same as SLTO duct heater initia- tion. Seizure in SLTO: Not applicable during further of augmentation. Initiation of augmentation. Not affected during duct heater initiation after rapid fill has been completed. Duct heater initiation after rapid fill has been completed. Zone I fuel flow constant at augmented PLA positions. Zone II cannot be initiated. Duct heater igniters remain energized during augmentation. The desired position. Seizure in the flow of duct heater shutoff after filled position. Seizure in SLTO: No immediate effect. Landing: Not affected. If maximum filled position. Where examins in the duct heater fuel pressure in creases to actima capability of duct heater tuel pressure in creases to actima capability of duct heater tuel pressure in creases to actima capability of duct heater tuel pressure in creases to actima capability of duct heater tuel pressure in creases to actima capability of duct heater tuel pressure in creases in the nooilating position. Gannet energize duct heater ignited mitiation of augmentation. Gannet energized initiation of augmentation.	Same as SLTO None		PRIMER ETFECT OR AARCTEST
Cruise Cruise St.ro:	Same as SLTO None		
St.TO:	None		SLT0 Same
Cruise Cruise		Not affected. If maximum Fn desired, desired, same as SLT9 duct heater initiation.	Cted None desii
Cruise SLTO:	ing Not applicable Not applicable entation.	fcable Not applicable	icable
Gruise SLTO:	g duct None Not affected	seted Not affected	cred
Cruise SLTO:	Voltage signal generator vill indicate duct heater igniters energized. Lower than	Fn = 70% Fnum. Continued AF and CK operation at this failure condition will shorten life of duct heater igniters.	×
Cruise SLTO:	normal to, no crupe in augmentation lev. vith PLA modulation.	If duct heater shut off: R = 65% Firms	Airo Eser.
SLTO:	d gaenta.		•
St.W:	Same as SLTO Same as SLTO e. Fna. 137 Fna. If duct heater Fn = 201 Fnate Fn = 201 Fnate	Same as SLTO except: Same as SLTO	57.12 24.13
15 Th	None	Not affected, If maximum \mathbf{F}_{H} Not affected desired, same as SLTO initiation,	cted None desi
	None	No irmediate effect. No immedia	No immediate effect. None
	culation fuel flow when duct heater off. Cannot initiate aug-	Cannot initiate augmentation AF and CR after abucoff. **Ter ** of Fram** On all the Make in non- Same as above.	# A
	mentation after shut off due to inability to energize duct heater 'gnition gniters. During attempt to initiate augmentation, duct heater fuel flow scheduled by EtA posi- tion and not main- tained at normal low value until Zone I manifold filled.	1	

Reduce to and/or main-tain nonsugaenced PLA range. Adjust Fn level on unaffected engines to obtain desired aircraft conditions. Use augentation for epergency only.

None

None

None, If maximum Fn desired, same as NITO duct heater initiation.

Crew Action Bequired

Same as SLTV.

Adjust F, level on unaffected engines to obtain
desired aircraft condition.
If necessary to mintain
oil temperature limit,
advance FA to ainfaus
augmentation level.

None. If maximum Fn desired, same as SLTO initiation.

None

Same as SLTO

Sheet

Fallere Effect on Aircraft Grow Action Boquired	Same as SLTO Same as SLTO	Not applicable None, It maximus Find the defined and selaure occurs, same as SLTO.		No immediate effect. None Adjust Fn level on unaffected engines to obtain desired afteraft conditions.	Same as SLTO Same as SLTO	Not affected None. If maximus Fn desired, same as SLTO initiation.		Not applicable None	Adjust Fn level cm un- affected engines to obtain desired air- craft conditions.	Same as SLTO Same as SLTO	The state of the s
	Sene	9		7. A.	Seme			Not a	allure AF and CR	Same	imum Not applicable
Failure Effect on Engine	Same as SLTO except: Fn = 20% Frma.	Not applicable. If maximum Fn desired and seizure occurs, same as SLTO.		No immediate effect. Pn = 65% Prma.	Same as SLTO except:	Not affected, If maximus Fadestred, same as SLTO initiation.		Not applicable	Fn = 65% Fnum. This failure condition will shorten the life of the duct heater igniters.	Same as SL10 except: Fn = 25% Funa.	Not applicable, If maximum F, desired and failure
Method of Betection	Same as SLTO	Not applicable		None After shutoff, camot reinitiate augmenta- tion.	Same as SLTO	None		Not applicable	Augmentation limited to minimum ratio level. Voltage signal generator will indicate duct heater ignites continuously levels.	Sane as SLTO	Not applicable
failure Effect on Sobsystem	Cruise: Same as SLTO	Landing: Not applicable, If maxi- mum Fn desired and seizure occurs, same as SLTO.		SLTO: No invediate effect. After duct heater shutoff, duct heater ignition system cannot be energized.	Cruise: Same as SLTO	Landing: Not affected, If maximum Fn desired, same as SLTO initiation,		SLTO: Not applicable during initial augmentation above minimum level.	Seizure can only occur during duct heater initiation. If this seizure occurs, duct heater itel flow limited to minimu ratio level. Also duct heater igniters remain energized at all PA levels.	Cruise: Same as SLTO	Landing: Not applicable, If maximum En desired and failure
Failure Mode				Seizure in ignition de- energized position.			Rupture	Seizure in ignition ener- gized posi-	tion.		
Feection				Positions the duct heater ignition switch for energizing and de- energizing of the duct heater ignities on	signal from the duck heater fill, shitoff, and dump control valve	as authorized by the Zone I manifold fill sensor valve. This valve also controls signals to the Zone I sachelle I finit valve during fultiation of augmentation.	Positions the duct neater ignition valve in response to positioning signal.	See previous descrip- tion.			
fee	Zone I Manifold Fill Sensor	Valve 25.2.20.9 or	Zone I Manifold Fill Sensor Valve Piston 25.7.20.10 (Continued)	Duct Heater Ignition Valve 25.2.20.11		0	Duct Heater Ignition Valve Diaphraym 25.2.20.12	Duct Heater Ignition Valve 25.2.20.11			

Sheet !
Unitized Control (Continued)

	Feection	Forlare Mode	Failure Effect on Subsystem	Method of Detection	failure tillect on Lagrac	Failere Effect on Airtraft	Crew Achies Reserved
Duct Hwater Ignition Valve Orifice 25.2.20.13	To sequence de-encr- gizing of the duct heater igniters after augmentation fuel flow has been established.	Di 44	SLTO: No immediate effect. For duct hearer initiation after failure, energizing of duct hearer igniters not affected. Slower than normal deenergizing of igniters and activation of Zone I duct hearer schedule limit valve with both functions dependent on leakage rate past duct heater ignition valve check valve.	No immediate effect during augmentation infitation. After failure, voltage signal generator will indicate duct hearer lighters energized lunger than normal. Augmentation level increase after initiation is delayed longer than normal.	No impediate effect, Aug- nentation initiation after failure will result in alover than normal augmenta- tion level increase after initiation.	OR immediate effect.	None. If augmentation increase delay is significant, adjust in level on unaffected engines until desired augmentation obtained on afficted engine.
			Cruise: Same as SLTD Landing: Not affected, If raximum Fn desired, same as SLTD initiation,	Same as SLTO None	Same as SLTO Not affected. If maximum Fn desired, same as SLTO initiation.	Same as SLTO Not affected	Same as SLTO None. If maximum Fn desired, same as SLTO initiation.
Duct Heater Ignition Valve	Provides rapid trans- lation of duct heater	Setzure in open position.	SLTO: Not applicable during initial augmentation.	Not applicable	Not applicable	Not applicable	None
Check Valve 25.2.20.14	gattion adve in duct baster igniters ener- gizing direction and to permit slover translation in de- energizing direction.		Failure can occur only during duct heater initiation. If this failure occurs, duct heater ignition valve translation in duct heater ignition and the initer de-energized direction vill be faster than normal.	Augmentation initia- tion after failure may result in inability to establish augmenta- tion.	After failure may not be able to ignite duct heater fuel framot establish augmentation: Fn = 65% Funa.	CR. If augmentation cannot be established, AF.	If augmentation cannot be established, adjust P. level on unaffected engines to obtain desired aircraft conditions.
-,			Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO
			Landing: Not affected. If maximum En delired, same as SLTO initiation.	None	Not affected. If maximum Fn desired, same as SLTO initiation.	Not affected	None, If maximum Fn desired, same as SLTO initiation.
Duct Heater Ignition Switch 25.2.20.15	On-off switch to energize or deerergize duct heater igniters.	a. Failure in energized position.	SLTO: Not affected.	Voltage signal generator will indicate continuous duct heater igniter energization,	Not affected. This failure will shorten the life of the duct heater igniters.	క	None
			Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	None
			Landing: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	None
		b. Failure in	SLTO: No ismediate effect.	No immediate effect.	No Immediate effect.	No immediate effect.	None
		deenergized position.	After failure, energizing of duct heater igniters can not be accomplished during augmentation initiation.	If duct heater shut off after failure, augmentation cannot be reestablished.	If duct heater shut off after failure, duct heater fuel cannot be ignited on subsequent augmentation initiation: Fn = 55F Fmas.	AF and CR	If duct heater shut off after failure, adjust En level on unaffected engines to obtain desired air- craft conditions.
			Cruise: Same as SLTO	Same as SLTO	Same as SLTO except: Fn = 20% Finns.		Same as SLTO
			Landing: Not affected. If maximum Fn desired, same as SLTO	None	Not affected. If maximum Fn Not affected desired, same as SUTO	Not affected	None, If maximum Fn de-

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Function	Failure Mode	Failure Effect on Subsystem	Merhod of Detection	Failure Effect on Engine	Sailore Effect on Aircraft	Crew Action Beggind
To limit Zone I fuel flow level until the Zone I manifold is	4	SLTO: Not applicable during initial augmentation above minimum level.	Not applicable	Not applicable	Not applicable	None
igniter has been de- energized, to shut off FLA activated airflow creased total engine creased total engine morrerion inteleston		For duct heater initiation after failure, duct heater fuel flow will be maintained at minima ratio level. Total airfley bias remains in effect during augmentation.	Augmentation limited to minimum ratio level.	Fn = 65% Fnra. Some increase AF and CR in total engine airflox.	AF and CR	Adjuar F, level on unaffected engines to obtain desired aircraft conditions.
in anticipation of	· upor promite de		Same as SLTO	Fn = 25% Fnma.	Same as SLTO	Same as SLTO
		Landing: Not affected, If maximum fn desired, same as SLTO initiation.	None	Not affected. If maximum Fn desired, same as SLTO initiation.	Not affected	None, If maximum F ₁₁ desired, same as SLTO taitiation.
	b. Selzure in non-laft- ing post- tion.	SLTO: No immediate effect. On duct heater initiation after failure, duct heater fuel flow will not be limited to minimum level during initiation. FLA activated total airflow bias signal will not be present during augmentation initiation.	None. None if minimum augmentation PLA used at initiation. If higher PLA used for initiation, duct heater may blow out.	No immediate effect. Duct heater may blow out upon initiation if high augmenta- tion PLA used.	OR inmediate effect.	None. Use ainimm augmentation PLA position for initla- tion.
		Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO
		Landing: Not applicable	Not applicable	Not applicable	Not applicable	None
To itmit Zone II fuel flow level until the Zone II manifold is	4	SLTO: Not applicable during initial augmentation above zone transfer.	Not applicable	Not applicable	Not applicable	None
full. To shut off PLA alrillow bias signal which increased rotal confine airflow during zone transfer in anticipation of transfer.	c fon.	For zone transfer initiation after failure, duct hearer fuel flow will be maintained at the transfer ratio value. Total airflow bias remains in effect during Zone II level of augmentation.	Augmentation insited to transfer ratio level.	En = 90% Fring. Some increase AF in total engine airflow.	AF and CR	Adjust F., level on un- affects, engines to obtain desired air- craft conditions.
		Cruise: Normally not applicable since normal cruise condition is with Zone I operated at cruise and seizure occurs, same as SLIO.	Normally not applica- ble. If setzure occurs same as SLTO.	Normally not applicable. Normally not if seizure occurs, If seizure occurs, Fn = 80% Fnna. Some increase same as SLTO. In total engine airflow.	Normally not applicable If seizure occurs, same as SLTO.	Normally not applicable, None. If seizure occurs, If seizure occurs, same as SLTO.
		Landing: Not affected, If maximum Fn desired, same as SLTO initiation.	None	Not affected, If maximum Fn desired, same as SLTO initiation,	Not affected	None. If maximum Fn desired, same as SLTO initiation.
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	Fenction	Failure Mode	Failure Effect on Subsystem	Method of Detection	Follore Effect on Engine	Feilere Effect on Aircraft	Crw Action Required
Zone II Schedule Linit Valve 25.2.20.17 (Continued)		b. Seizure in non-limiting posttion.	SLTO: No immediate effect. On duct failure. Zone II fuel flow vill not be limited to transfer. FA artfow being transfer. PA artfow beas signal will not be present during zone transfer.	None. None if minimum transfer FLA used at transfer. If higher FLA used for transfer Zone II may blow out.	No immediate effect, Zone II may blow out upon initia- tion if high Zone II PLA used.	No immediate effect.	None. Use minimum PLA position for transfer.
		•	Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO
	-		Landing: Not rpplicable	Not applicable	Not applicable	Not applicable	None
	Total engine airflow bias signals for duct	a. Seizure in position to	SLTO: Rapid PL, transients during augmentation not affected.	None	Not affected	Not affected	None
Signal Selector In Alive	transients are utilized during the transient and can originate from the duct schedule valve during large rapid PLA	pass only the bias signal from the duct schedule	During initiation of duct heater fuel flow or initia- tion of zone transfer, the airflow blas signal will not be passed to the total air- flow reset piston.	Normal engine total airflow increase during augmentation initiation or zone transfer will not occur.	Engine not appreciably affected.	క	If desired, use mini- mum PLA positions for initiating augmentation and one transfer to minimize these transfers.
- 144	PLA positioning for		Cruise: Samu as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO
	augmentation initia- tion and for zone transfer. This selector valve is positioned to	-	Landing: Not affected, If maximur. Pn desired, same as SLTO.	None	Not affected, If maximum Fn desired, same as SLTO.	Not affected	None. If maximum Fn desired, same as SLTO.
W 3	pass an airflow bias signal from either source and block the	b. Seizure in position to pass only	SLTO: Initiation of duct heater fuel flow or zone transfer not affected.	None	Not affected	Not affected	None
	nonsignaling port when- ever a bias signal is present.	signal from Fig. 1974 post-tioning for duct heater	During large rapid PIA transients in augmented range, the airflow bias signal will not be passed to the total airflow reset piston.	Normal engine total Engine nor airflow increase during affected. large rapid augmented FLA transients will not occur.	Engine not appreciably affected.	క	If desired, use slow FLA movements in aug- sented range to mini- mize this transient.
-			Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	Same as 51.70
		transfer.	Landing: Not affected. If maximum Fn desired, same as SLTO.	None	Not affected, If maximum Fn desired, same as SLTO.	Not affected	None. If maximum F_n desired, same as SLTO.
u = c	Provides rapid trans- lation of engine total	Seizure in open position.	SLTO: Translation of airflow reset piston in reset direction not affected.	None	Not affected	Not affected	None
25.2.20.19 t	in reset direction and to permit slower translation to remove the reset.		Translation of airflow reset piston to remove reset will be faster than normal.	Removal of total air- flow bias will be faster than mormal after large rapid PIA augmentation tran- sients, initiation of augmentation and zone transfer.	Engine not appreciably affected.	ಕ	If desired to minimize transients, use cindam FA positions for initiation of augmentation and zone transfer. Also use slow FA augments.
·			Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO
40 1 1221 - 10 1221 - 124 2 - 100 100 114 12 12 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	G COUTHLANTING 12777 F.co.				Andred by: Webste	Court The 11 out of the	25 9/17/66 TE PRINTI PITE

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Failure Effect on Aircraft Crew Action Baquired	None. If maximus Findesired, same as SLTO.	None	None	.70 Same as SLT0	ied. Kone. If maximum Fn desired, same as SLPO.	If desired, use minimum PLA positions for aug- mentation infliction and some transfer and use slow augmented PLA movements.	.TO Same as SLTO	ted News, If maximum En des, d, same as SLTO.	None	.TO None	None
Feilers Eff	Not affected	Not affected	ಕ	Same as SL70	Not affected.	5	Same as SLTO	Not affected	AF and CR	Same as SLTO	Not applicable
Feilere Effect on Engine	Not affected, If maximus Fa desired, same as SLTO.	Not affected	Engine not appreciably affected.	Same as SLTO	Not affected. If maximum Fn desired, same as SLTO.	Some reduction in surge margin during transfents.	Same as SLTO	Not affected. If maximum Endesired, same as SLTO.	Fn = 95% Fnms.	Fn = 95% Frame.	Not applicable. If maximum Fn desired and failure occurs, same as SLTO.
Method of Detection	None	None	Removal of total air- flow bias will be alover than normal after large rapid PIA augmentation transferita infiation of augmenta- tion and some transferita	Same as SLTO	None	Normal engine total airflow increase auril outling augmentation transitor perioda will not occur.	Same as SLTO	None	Engine total airflow increase normally associated during transferts only, will now be in effect during augmentation.	Same as SLTC	None
Failure Effect on Subsystem	Landing: Not affected, If maximum Fn desired, same as SLTO.	SLTO: Translation of the airflow reset piston in reset direction not affected.	Translation of airflow reset piston in reset removal direction slower than normal, rate dependent upon leakage through reset piston check valve.	Cruise: Same as SLTO	Landing: Not affected. If maximum Fn desired, same as SLTO.	SLIO: During transfents of large rapid augmented FLA move- rents, augmented initiation, and zone transfer, the engine total airilow will not be increased during the transfents.	Cruise: Same as SLTO	Landing: Not affected. If maximum Fn desired, same as SLTO.	SLTO: Failure can only occur during large rapid augmented FLA movements, infitation of augmentation, or zone transfer. If failure occurs, the engine total airflow bias remains in effect during augmentation.	Cruise: Same as SLTO	Landing: Not applicable, If mixt- mum Fn desired and failure occurs, same as SLTO.
Failure Mode		Flugged orf- fice.				a. Seizure in non-reset position.			b. Seizure in Reset Position		
Function		To delay translation of engine total airflow reset piston in direc-	tion to remove the reset.			On rectiving appro- prise signals, pro- v. as bias to the engine total airflow control system to in- crease airflow in order to provide additional	surge margin during large rapid augmented	FLA movements, aug- mentation initiation, and augmented zone	transfer.		
1	Total Engine Airflow Bias Reset Piaton Check Valve 25.2.20.19 (Continued)	Total Engine Airflow Bias Reset Piston	07.1ffce 25.2.20.20			Total Engine Airflow Blas Reset Piston 25,2,20,21					

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Unitized Control (Continued)	(Continued)						
Hom	Fraction	Failure Made	failure Effect on Subsystem	Method of Detection	Failure Effect on Engine	feilure Effect on Aircraft	Crew Action Required
Duct Heater Primary Combustor Fressure, Pg. Sense System 25.2.21	Provides a multiplying force proportional to P E to the duct heater schedule and to computation system.						
P. Sense Bellows 25.2.21.1	Transmits Pm pressure level as a force to the Pm mulitplying lever.	Sense bellous rupture or	SLTO: Effective P _B is less than normal resulting in duct heater fuel flow approximately 90% of normal.	Duct heater fuel flow less than normal.	FN = 95% Fnma	AF and CR	Remote duct heater fuel flow adjustment will essentially compensate for re-compensate for re-fuction in effective P _B .
P _B Evacuated Bellows 25.2.21.2	Supplies additive force proportional to abside pressure so that Pa force transmitted to Pb multiply-ing lever is based on Pa absolute pressure level.	Evacuated bellows leak or rupture.					
			Cruise: Same as SLTO except duct heater fuel flow is approximately 80% of normal	Same as SLTO	FN = 85% Fina	Same as SLTO	Same as SLIC
			Landing: Not affected	None	Not affected	Not affected	None
. —			If maximum En desired, same as SIIO.		If maximum Fn desired, same as SLTO.		If maximum Fn destred, same as SITO.
P Multiplying Lever Seal Bellows 25.2.21.3	Scals P bellows ambient pressure cavity from control case pressure.	Leak or rupture	SLTO: Fuel leakage overboard through the P _B housing drain. Rate of fuel leak- age restricted by an orifice. P _B sense system essentially not affected by fuel pressure in ambient cavity.	Overboard drain leakage from P _B housing drain.	Yot affected	K	None
. —			Cruise: Same as SLTO	Same as SLTO	Not affected	Same as SLTO	None
			Landing: Same as 5LTO	Same as SLIO	Not affected	Same as SUTO	None
	AP C LELL VELICIPATE SOIL E SUI CTTE OF STORY AND				Analyzed by: White	Sum Pill The Strate	e Te Wele

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JTF17 FAILURE MODE & EFFECT AKALYSIS

Ness Bequired		1¢ ves 1¢ ves tystem and the	अ शामिक
Crew Action		his system breakage. ect this s sented in	
fellers Effect on Aircraft		Parts within this system consist preclude their breakage. It was systems will affect this system and systems are presented in the	Wohn this The Malle
		mergin control a control a mergin control a co	24/14
Failers Effect on Engine	·	reserved in the event of future need. be designed with sufficient margin to silures within other unitized control sy ar scheduling and fuel flow computation or scheduling and fuel flow computation.	
-		rsserved in be designed be designed in a cheduling a string a stri	Anolyzed by:
Method of Detection		control system has been re which are considered to ratem will not occur. Fai effect on the duct heaker	
Father Effect on Sebsystem		The Pailure Mode Index Number for this unitized control system has been reserved in the event of future med. Peres within his system considered to a cam, springs, relieve, and various linkages which are considered to be designed with sufficient margin to preclude their breakage. It was saxumed that failures within this system will not occur. Failures within other unitized control system will affect this system analysis of the appropriate system. The system of the control of the co	
Feilure Mode		The Failure of a cam, of a cam, of a sauced there the total a analysis of	
Function	A feedback force bal- ance system that computes and controls duct heater fuel flow. Total flow ratio, Wg/By, is scheduled as a fun- tion of PLA and TC2. Wg/Py, is smalttplied by the Py signal from the duct heater Py sense duct heater fuel flow. The system controls the duct heater throttle valve system by providing a fuel flow derand sig- nal and receiving a fuel flow derand sig- nal and receiving a fuel flow derand sig- nal show feedback		an 1 1717, helitelminos ec
	Duct Heater Scheduling and Fuel Flow Compute- tion System 25.2.22	,	50 4 17.71 helitypungs 600 P alu 11150 De 910401 sud

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Unitized Control (Continued)	(Continued)						
4	Function	Foilere Mede	Failure Effect on Subaystom	Method of Detection	Feilere Effect on Engine	Fellers Effect on Aircraft	Crow Action Bequired
Duct Heater Fuel Inlet Filter 25.2.23	Contamination protection. All fuel entering contamination the dure haster system deposited on is passed through a servo filter 20 mesh strainer, servo fuel is passed through a 40 micronic wash type filler. A relieving by-pe filler. A relieving by-pe filler for the servo filter.	Excessive g contemination deposited on servo filter 1	SLTO: When fuel pressure drop across the servo filter exceeds a presel level, the servo filter bypass valve opens allowing strained fuler fuel to bypass the servo filter. Contaminant may enter the duct heater servo system. Dependent on the size and amount of contaminant, failures may occur in the control servo system.	Excessive contaminant in the filter and corrective section can be controlled in most instances by normal periodic inspection and maintenance.	No immediate effect.	No immediate effect.	None
			Cruise: Same as SLTO	Same as SLTO	No immediate effect.	No immediate effect.	Nore
			Landing: Same as SLTO	Same as SLTO	No immediate effect.	No immediate effec	None
		_			•		

Į	Tarefier Franchis	Pailure Made	Feilers	Foilure Effect on Subsystem	Method of Detection	Feilure Effect on Lapine	Feilers Effect on Abrordt	Core Acties Bequire
Duck Rester Throttle Valve System 25.2.24	Duct head of the duct head of the post the post thrutth thruth the thruth	i						
Duct Heater Flictile Valve 25.2.24.1	Positions the throttle avaive by modulating throttle valve servo pressure in response to the feel flow signal from the duct heater schedule and	a) Seizure in decrease metered fuel flow side of null	SLTO: Duct h is sch fuel i	Duct heater thruttle valve is scheduled to minimum fuel flow position.	Duct heater blows out if on or can not be initiated if off.	Duct heater fuel flow scheduled at minimum flow resultable for a duct heater blow out if on or can not be initiated if oil. Fn * 657 Fma	AF and CR	Reduce to and/or maintain non aug- mented PLA range. Adjust Fn level on unaffected engines to obtain desired air- craft conditions.
	system.	T O'NE OR STORES THE SERVICE SERVICES SERVICES	Cruise: Same	Some as SLTO	Duct heater fuel flow at minimum flow value.	FN - 251 FNW	Same as SLTO	Adjust fn level on unaffected engines to obtain desired air- craft conditions.
			Lending: Not Fn	Not affected if maximum En desired, same as SLIO	Duct heater blows out if sugmenting during descent None	Duct heater bloas out if eugmenting during descut Not Affected. If maximum En desired, sace as \$170.	Not affected.	If duct heater blows out on descent, same as SLFO. Note the same as the desired, sume as SLFO
			and the second control of the second control					

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Unitized Control (Con't.)		Failure Mode	Fuilure Effect on Subsystem	Method of Detection	failure Effect on Engine	Failure Effect on Aircraft	Grew Action Boquired
Duct Heater Throttle Valve Pilot Valve 25.2.2.1 (continued)	(Seizure in increase metered flow iloul ilow side of null	SLTO: Duct heater throttle valve is scheduled to maximum fuel flow position. Duct heater fivel flow can not be modulated with PLA or Tr2 blas.	buct heater fuel flow scheduled to maximum fuel flow and can not be modulated with PLA. On augmented clinb, duct heater will event ually blow out	Fn = 105% Frms	AF and CR	After SLIO, Retard to and/or maintain non augmented PLA range. Adjust Fin level on unaffected engines to obtain desired alforati conditions. Use augmentation for emergency use only.
			For duck heater shut off, circulation flow will remain at maximum duct heater inel flow.	For duct heater shut off, circulation fuel flow will remain at maximum duct heater fuel flow	Not affected system can handle level of circulation flow	5	None
			Cruise: Same as SLTO	Same as SLTO, except engine surge and duct heater blows out	Same as SLTO except engine surge and duct heater blow out. Fn = 20% Fnma	Same as SLTO	Retard to and/or maintain non augsen- ted PLA range. Adj- ust Fin level on un- affected engines to obtain desired air- craft conditions.
			Landing: Not affected, if maximum Same as SLTO fn desired, same as SLTO	Same as SLTO	Not affected, If maximum Fn desired, Same as SLTO	Not affected	None If maximum for desired againsticon availa- ble for energency conditions.
	** ((.) ***				Ambried by: 166.50	When the Will Harming But 186	9) al b 32 m

-	Unitized Control (Con't.)			Section of the last of the las			
2	Function	Fullery Mode	Follows Effect on Subsystem	Method of Detection	Fuilers Effect on Engine	Failure Effect on Abroraft	Cros Action Bequired
Dut heater theutile valve 25.2.24.2	Duct heater fuel flow	See 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	SLIO: Duct heater fuel flow remains at level scheduled at time of failure and can not be modulated with FLA or Tt2 biss.	No immediate effect Duct heater fuel flow can not be modulated with PLA and will not follow normal TZ, altitude schedule. Kill eventually blow out on climb.	No immediate effect Duct heater fuel flow will not follow normal PLA altitu- ude schedule. As altitude is increased duct heater fuel flow will eventually be excessive for conditions and duct heater will blow out.	No immediate effect CR When duct heater fuel flow becomes excessive for conditions, AF	None Mean meressery, reduce to and/or meintain non aug- mented PlA range. Adjust Fn level on unaffected engine to obtain desired aircraft conditions.
			Cruise: Same as SLTO	Same am SLTO	No immediate effect. If conditions aignificantly change from those at time of failure, duct heater fuel flow utill be improper and may result in duct heater blow out	Ko immediate effect	Mone If duct heater blous out, reduce to and/ or maintain non or majurented PLA range. Adjust Fn level on unsifiected engines to obtain desired sircraft conditions.
			Landing: Not affected. 15 maximum. Fn desired, same as SLTO	Not affected	Not affected. If maximum Pu desired, duct healter total desired, duct healter total augmented effeculation flow level resulting in essenti- ally minimum augmentation level. Fn = 65% Fnma	Not ffected	None If maximum for desired adjust for level on unaffected engines to obtain desired afreeft conditions.
4 8 84. 1.110 Pa 880.01	And restly wearest when a way a major restly des delivers and				Analyzed by: Ulange	Jane Will The Shelle	12 4 4 12 86 AF 27

ITF17 FALLINE MODE & EFFECT ANALYSIS

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	Freches	Failure Mode	Failure Effect on Subsystem	Merhad of Detection	Forlare Effect on Engine	Feilere Effect on Airtraft	Crew Action Required
Duct Heater Throttle Valve Fressure Regulating System 25.2.25	Regulates throttle valve differential pressure to a constant value so that throttle valve position is proportional to metered fuel flow.						
In Line Pressure Regulating Valve Sensor 25.2.25.1 or or In Line Pressure	Modulates pressure regulating valve integral piston pres- sure in response to sensor throttle valve differential pressure,		4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Approximately 8% Duct heater increase in duct heater than normal. fuel flow.	fuel flow higher		Adjust PLA or remote duct heater fuel adjustment to correct for fuel flow increase.
suce Regulating Valve Integral Piston 25.2.25.2	tegulation function to pressure regulating valve spring for icproxed regulation by anniating spring rate affect on pressure regulating valve position.	in full author- ity position for increase in throttle valve dif- ferential pres- sure.	increase in duct heater fuel flow. Cruise: Same as SLTO except throttle valve differ- ential pressure increased approximately 30, and approximately 32 increase in duct heater flow.	Approximately 5% increase in duct heater fuel flow.	Same as SL70	Same as 51.70	Sane as SLTO
			Landing: Not affected. If maximum: Pn desired, same as SLTO.	Same as SLTO	Not affected. If maximum Fn desired, same as SLTO.	Not affected.	None. If maximum Fn desired, same as SLTO.
		b) Sensor seizure in from inil to decrease throttle valve dif- ferential presoure. er	SLTO: Pressure regulating valve integral piston at full authority position for decrease in throttle valve differential pressure. Regulation vill be maintained by the proportional pressure regulating valve at a level approximately 17 lover than normal. Approximately 8% decrease in duct heater fuel fig.	Approximately 8% buck heater decrease in duct heater than normal, fuel flow.	fuel flow lover	ő	Adjust remote duct heater fuel duct heater fuel colsistent to colsistent for fuel flow decrease.
		full author- full author- for decrease in throttle valve dif- ferential pressure.	Cruis	Approximately SX decrease in doct heater fuel flox.	Same as SLTO except Fn = 95% from		Same as 51.70

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Crew Action Bequired	None, If maximum Fn desired, same as SLTO.	None	Adjust Fn level on unaffected engine to	obtain desired aicrast con- ditions.	Duct heater fuel flow correction can be sade with PLA until reaching win augmented PLA position. If win-imam augmentation desired, reduce TLA to non-augmented on affected engine and adjust Fn level on unaffected engines to obtain desired aircraft conditions.	4
Failure Effect on Aircraft	Not affected.	No immediate effect.		AF and CR	ర	0,,
Follors Effect on Engine	Not affected. If maximum Pn Not affected desired, same as SLTO.	Wo immediate effect.		Duct heater fuel flow less than normal with deviation dependent on amount of schedule change from conditions existing at time of failure.	Duct heater fuel flow greater than normal with deviation dependent on amount of achedule change from condition existing at time of failure.	977
Method of Detection	Same as SLTO	Duct heater fuel flow will deviate from soreal sekuling as conditions change from those existing at time of failure.		Duct heater fuel floy less than normal	Breater than normal	
Failure Effect se Sobsystem	Landing: Not effected. If maximum Fn desired, same as SLIO.	SLTU: Lose in-line pressure regulator modulation to con- regulator modulation to con- froi frontile valve dif- ferential pressure. Versure and in-line pressure regulator to normal value. Normal duct heater fuel flow vill be maintained for con- ditions existing at time of failure.	As conditions change from those at time of failure, effect will be as follows:	Scheduled duct heater throttle Duct heater fuel flow valve increase flow position-less than normal. If well result in duck will result in duck less than normal. Amount of flow deviation from normal dependent on amount of schedule change from that estiting at time of failure. Buck heater fuel flow increase limited to a maximus of approximately 60% greater than that at time of failure.	Schedulad duct heater throttle Duct heater fuel flow valve decrease flow position- greater than normal ing will result in duct heater than normal gual result in duct heater than normal for the new position. Amount of flow deviation from one position amount of schedule change from that exhedule change from that existing at time of failure. Level above new position normal will not exceed approximately 60% greater than new position normal.	
Failure Made		e 177 187 187 187				
Function		Regulates throttle valve differential pressure by varying restriction in metered flow path.				11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Pen		In-Line Pressore Pressore Value 25.2.25.3				20 CO

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Collete State at SETO Collete For a series SETO	res Frenction	Fuilers Made	Failere Effect on Subsystom	Method of Detection	Failore Effect on Engine	Failure Effect on Aircraft	Crew Action Required
Landing: Not affected. If marians Same as SLO					Same as SLTO	Same as SLTO	Same as SLTO
Oriffice plugs SITO: Find presented and Date Marter (and 1600 will need to concelling approximately with point from village approximately from the concelling approximately from the concelling and the con		***			Not affected. If maximum F, desired, same as SLTO.	Not affected.	None. If maximum Fn desired same as SLIO:
Not affected. If maximum Same as SLTO Not affected. If maximum Fn Not affected. If desired, same as SLTO. Fn desired, same as SLTO.	Dampens metered pressure signal for duct heater fuel flow stability	Ortfice plugs		Duct heater fuel flow flow will tend to oscillate approsi- mately ± 5% from nor- mal.	Duct heater fuel flow will tend to oscillate approximately \$ 3% from normal.		After SLTD if oscillations are objectionable, reduction of PLA vill ainimize the magnitude of the oscillations.
Same as SLTO Not affected. If maximum Fn Not affected. desired, same as SLTO.				Same as SLTO	Same as SLTO	Same as SLTO	Same as N.TO
			Landing: Not affected. If maximum Fn desired, same as SLTO.	Same as SLTO	desired, same as SLTO.		None. If maximus Fn desired, same as SLTO.

Sheet ! Univised Control (Continued)	(Continued)		JIFI/ FAILURE MUUE & EFFEGI AMALTSA	& EFFECT ANALYSES		*	
Heat	Function	Failure Mode	Fuilure Effect on Subsystem	Method of Detection	Follure Effect on Engine	Failure Effect on Aircraft	Cree Action Bequired
Duct Heater Secondary Cool- ing Flow Valve 25.2.26.1	Ensures minitann fuel flow level from duct heater purp to unitized control for proper engine oil cooling.	a. Sefzure in non-bypass position.	SLTO: This is normal position for augmentation at this condition. Also this is normal position for all nonaugmented conditions.	None	Not affected	Not affected	None
			During augmented climb when metered duct heater fuel flow is reduced below approximately 3000 pph, the throttle valve serondary cooling walve to the bypass condition. See seizure in bypass position.	See item (b) seizure in bypass position.	See item (b) seizure in See item (b) seizure in by- bypass position. pass position.	See item (b) seignre in bypass position.	See item (b) seizure in bypass position. bypass position.
			Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	Same as SLT0
			Landing: Not affected	None	Not affected	Not affected	None
		posítion.	During climb when augmented metered duct fuel flow is below approximately 3000 pph, duct heater throttle valve positioning will drive the cooling valve into the bypass position required to maintain proper duct heater pump delivered fuel flow for adequate oil cooling. On subsequent increase in metered duct heater fuel flow above 3000 pph or duct heater fuel shuroff, the seized cooling flow valve will remain in the bypass position. Amount of bypass fuel flow dependent on lowest level of duct heater metered flow will remain in the bypass fuel flow dependent on lowest level of duct heater metered flow above creased or shut off.	not applicable After reducing duct After reducing duct below 3000 pph, sub- sequent increase in sequent increase in sequent increase in sequent increase in sequent increase into flow or flow abut- off will result in measured duct heater itel flow being higher than normal.	Not affected	Post Photos Control of the Control o	Non Year
			Cruise: Same as SLTO, low duct heater fuel flow.	Same as SLTO, low duct Not affected heater fuel flow,	Not affected	Same as SLTO, low duct None heater fuel flow.	None
			Landing: Not applicable	Not applicable	Noc applicable	Not applicable	Not appilicable
P&& 107648 PO 61773 (7E)	Fee 107548 FO 61713 (TEM & 100 60-(14241)186 (1727 746				Analyzed by: Villen	When I find the The Shalle	14 9 4 9 46 H

Sheet ! Unitized Control (Continued)

-	Failure Effect on Aircraft Crew Action Required		None None	Same 4. SITO None	Same 44 SLTV	Same 4.9 SITO Same as SITO AF and CR	Same 4s SLTO Same as SLTO AF and CR Same as SLTO. Also, nay have IFS.
	Feilure Effect on Engine		y Not affected. Duct heater control will maintain proper r-fuel scheduling.	Same as SLTO			Ed.
	Method of Detection			nonaugmented engine operating conditions.	nonaugmented engine operating conditions. Same as SLTO Same as SLTO	nonagmented engine operating conditions. Same as SLTO Same as SLTO Duct heater fuel flow essentially zero. Duct heater shuts off if on or cannot be initiated if off.	nonagmented engine operating conditions. Same as SLTO Same as SLTO Same as SLTO buct heater fuel flow essentially zero. Duct heater shuts off if on or cannot be initiated if off. Same as SLTO
	Failure Effect on Subsystem		SLIO: Butterfly valve positioned to maximum position. Pump speed is increased and duct heater fuel system pressure level is increased.	Cruise: Same as SLTO		w + 1 × 1 × 1	Cruise: Same as SLTO Landing: Same as SLTO SLTO: Butterfly valve positioned to minfaum position. Pump speed reduced to low level. Duct heater fuel flow reduced to essentially zero. Cruise: Same as SLTO
-	Fuilure Mode		Seizure (Low differential pressure post-tion.)		Seizure (Low 1 differential pressure posi- tion.)		
	Forction	Controls bleed air to pump turbine to drive the lowest apped which will provide the requested fuel pressure. A remote mounted actuator is utilized to modulate a butterfly valve in the duck supplying bleed air to the pump turbine		reater control ther to regulating valve down-stream differential pressure.			oi inser to rential f split f split gystem Provides egrating ilot valve- functional
	1	Duct Heater Fuel C Turbopump Con- troller System ((Butterfly Valve Remote Mounted) v 25.2.27	Filot Valve - Regulating Valve to Downstream Pres- a sure 25.2.27.1		Pilot Valve - O Control Inler P Pressure (25.2.27.2 P	E	

Failure Effect on Sobsystem Method of Detection Fa	failure Effect on Engine	Failure Effect on Aircraft	Crow Action Bequired
Dependent on seizure post- tion. For seizure close to null where the split pilot valve can handle the increased servo flow, the split pilot walve will still control the pump butterfly valve although control will be somewhat salower than normal. Duct hatter fuel system fuel pressure will tend to be in- creased and will fluctuate. Duct heater fuel flow will twnd to fluctuate.	Essentially not affected.	5	None
For science positions of Ground check butter- Not af larger excursion from null, fly valve position control the butterfly valve position. butterfly valve open duct heater fuel system and all nonaugmented pressure level is increased engine operating conditions.	Not affected, Duct heater control will maintain proper fuel scheduling.	5	None
Cruise: Same as SLTO Same as SLTO Same a	Same as SLTO	Same as SLTO	None
Landing: Same as SLTO Same as SLTO	Same as SLTO	Same as SLTO	None
SLTO: Dependent on seizure posi- tion. For seizure close to null buct heater fuel flow Essent where the split pilot valve will tend to fluctuate. can handle the increased served flow the solite pilot	Essentially not affected.	ť	None
walve uils still coritoi the pump butterfly valve although control will be somewhat control will be somewhat theater then normal. Duct the fluctuate.			
For seizure positions of Duct heater fuel flow Fn = 652 Fn the varieties of the formulally serve, Duct the varieties of the formulally served to ease the fuel flow and if off.	52 Fn ma·	AF and CR. Also, may have IFS.	Reduce to and/or maintain nonaug- mented PLA range. Adjust En level on unsaffected engines to obtain desired aircraft
			conditions.
	100	1	2 Jace
	Y	Analyzed by: William	Analyzed by: Walter Field The States

Sheet 1

-1	Unitized Control (Continued)					-	
Function		Failure Mode	failure Effect on Subsystem	Method of Detection	failure Effect on Engine	failure Effect on Aircraft	Grew Action Required
			Cruise: Same as SLTO	Sane as SLTO	Fn = 202, Fn ma. In addi- tion, oil temperature will increase and may eventually exceed limits due to loss of durt heater oil cooler fuel flow.	Same as SLTO. Also, may have IFS.	Some as SLIO. In addition, monitor engine oil ter- perature. Nay be necessary for IFS and if necessary to maintain oil terper- maintain oil terper- ature lifeit, reduce additions, subsonic conditions.
			Landing: Same as SLTO. Duct heater flow may not be availa- bie. See SLTO,	Same as SLTO .	Not affected. Maximum Fn may not be available. See SLTO.	Not affected	None. Same as SLIO if maximum F desired.
Modulated by pump or troller to position the pump butterily valve.	Modulated by pump controller to position the pump butterfly valve.	Seizure (Duct heater on position.)	SLTO: For duct heater fuel flow denand near or less than that at time of failure, pump speed and duct heater fuel system pressure level will be higher than normal as fuel flow denand is decreased from that at time of failure.	Ground check butter- fly valve position indicator will show butterfly valve in augmented position at engine shutdown and all nonaugmented engine operating conditions.	Not affected, Duct heater control will maintain proper fuel scheduling.	• &	Уопе
			For duct intater fuel flow demand considerably higher than that at time of failure, energy to pump will mote be sufficient to meet demand. The duct heater swatem in-line pressure regulating valve will attempt to maintain throttle valve differential pressure and may fmose too high a pressure level for the fuel pump to handle, Duct heater fuel flow may decrease to essentially zero.	Outt heater may flame out.	If duct heater flames out, Fn = 65% Fn.	If duct heater flames out, AF and CR.	If duct heater initiate if desired. limit position and lower.
			Cruise: Same as SLTO	Same as SLTO	Same as SLTO except Fn = 20% Fn ma.	Same as SLTO	Same as SLTO
			Landing: Not applicable. If seizure occurs in duct heater off position, duct heater fuel flow not available.	Not applicable	Not applicable, If maximum Fn desired, Fn = 65% Fn ma.	Not applicable	Not applicable, if desired, maximam for desired, maintain PLA in nonaugemented range. Adjust 7, level on unaffected engines to obtain deverdairents conditions.

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Anotyzed by:

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Crew Action Depaired	Kone	Maintain non-sug- mented TLA range. Adjust Fn level on unaffected engines to obtain desired aircraft conditions.	Same as 5LTO	Mone. Same as SLTO non-augmented conditions if maximum Fn desired.		FRORCT DATE
Fullers Effect on Aircraft	Not applicable	Af and CR	Same as SLTO	Sece as SLTO		DATE RELIABILITY DATE
failure Effect on Engine	Not applicable	Fn = 65% Fn ma.	Same as SLTO except for condition where duct heating cannot be initiated. Fig. 20% Fig. ma.	Not affected, Maximus Fn limited to SLTO non-aug- mented conditions.		Anniytes by: Viction Illasto
Method of Detection	Not applicable	Duct heating cannot be initiated.	Same as SLTO	Not affected.		
Failure Effect on Subsystem	SLIO: Not applicable for duct heater on conditions.	For duct heater off condi- tions, cannet initiate duce heater fuel flow,	Crusse: Same as SLTO	Landing: Not affected. Dict heating fuel flow not available.	•	
feilere Mode	Seizure (Duct heater off	position.)				
Function					*** () () () () () () () () ()	
Hea	Remote Butter- fly Valve	Actuator Piston 25.2.27.4 (continued)	e e e e e e e e e e e e e e e e e e e			

Sheet ! Unitized Cor

Crew Action Required	None	None If desired, use remote engine total airflow adjustment.	Kone	16 76 9/12 66
Failure Effect on Airtraft	No immediate effect	Not applicable AF and CR	8	MAL States The Street
Failure Effect on Engine	No immediate effect in range where compressor in let guide vanes normally at start-cruise position there will be an increase in engine total affilow with increase reaching peroximately \$7 above normal af criise.		Not appreciably affected	Analyzed by: / Benese
Merhod of Detection	None Some increase in engine total airflow in range where compressor inlet guide vanes normally in start-ruise position,	Not applicable Approximately 5% increase in engine total afrilow.	Hone	
Failere Effect on Subsystem	SLTO: No immediate effect. On climb the compressor inlet guide vanes will not be positioned to the start cruise position.	Cruise: Normally not applicable If Ny reduced below actuation level and seizure occurs, com- pressor inlet guide vanes remain in SLTO position after seizure.	Landing: For this failure to occur, landing Ny must be above actuation level to be in SLTO position. If failure occurs, the compressor inter gride vanes will remain at the SLTO position when My reduced below actuation level.	
Failure Mode	Seiture in SLTO SLTO: position Seiture in			
function	Provides high pressure fuel signals to the compressor fallet guide positioning in either the start-cruise or SITO positioning is controlled as a function of N2 and T _L 2. Controls positioning of the compressor fallet guide vanc control of N2 and T _L 2. Controls positioning of the compressor fallet guide van control of N2 and T _L 2.	the value actuators as signaled by the compressor inlet guide vane pilot valve.		** * * * * * * * * * * * * * * * * * *
Unitized Control (Continued)	Compressor Inlet Guide System 25.2.28 25.2.28 Compressor Inlet Guide Valve 25.2.28.1 or	Vane Control Valve 25.2.28.2		. wit. 1/55 pg \$50,01 +#4

Unitized Control (Continued)

Į	Function	Failure Made	Fuilare Effect se Sadeystem	Method of Detection	failure Effect on Engine	Federa Effect on Aircraft	Core Action Beguine
Compressor Inlet Guide Vane Pilot Valve 25.2.28.1	Sce previous description	Seizure in start-cruise position	If pilot valve seizes in this posit time SLTO positioning is scheduled	ion during start or crui See previous analysis	to valve seizes in this position during start or cruise conditions, it will be drifen to the SLTO position the first to positioning is scheduled. See previous analysis for seizure in SLTO position.	en to the SLTO position	the first
Compressor Inlet Guide Vane Control Valve 25.2.28.2	See previous description	Seizure in start-cruise position	SLTO: Not applicable Cruise: No immediate effect. On descent, the compressor inlet guide vanes will remain in the start-cruise position	Not applicable None During descent at nor- ani SLTO position of compressor, fallet guick vanes:	Not applicable No immediate effect	Not applicable No impediate effect	None None
				Minor increase in N2 and decrease in duct nozzle area at lover three-fourths of non-augmented PLA range.	At lower three-fourths non- augmented FLA range, engine not apprectably affected.	Not appreciably affected	None
		,		At upper quarter of nonaugmented PLA range, N. increase and duct nozzile area ducrease as alitude and Itz derrease.	Some reduction in Fn with reduction becoming larger as altitude and Tr2 decrease.	AF and CR	Use FLA or remote PRE adjustment to adjust Fn level on affected engine.
				At sugmented PLA range, Ny increase and duct noxitize decrease with eventual engine surge as allitude and Try decrease.	Some reduction in Fn with reduction becoming larger as altitude and fig decrease. Evenual engine surge limiting Fn to less than normal maximum nonaugmented.	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	For the tro ERR at forcest advanta- crate. Ad st For- lead to smallested engines to chian desired afrected differs. Affected engine eventually limited to non- augmented PLA range.
			Landing: For this failure to occur, Ny must be reduced below actuation level. If failure then occurs, no immediate effectures	None	No izradiate effect	'No izzediate effect	None
			If maximum F, desired, compressor inter guide vanes vill remain in start-cruise position.	If maximum Fn desired, Ny higher than normal, duct nozzle area less than normal. Engine surge if augmentation attempted.	If maximum Fn desired, enging AF and CR surge if augmentation attempted, Fn = 402, Fnna. Reverse Fn lower than normal.	AF 200 CR	Adjust Fn level on unaffected engines to obtain desired aircraft conditions.

Sheef ! Unitized Control (Continued)

Į			Feiture Effect on Sederation	Method of Detection	Taskers (thect on forms	Faller Black on Aircraft	
Supressor Contra System 25.2.29	Supersor Control sure to the reverser- System suppressor actuator 25.2.29 for positioning for positioning for controlled by PLA when authorized by N2 level. The PLA failture effects are manalyzed in the power lever boost section 25.2.2 The failure effects of the speed suthorized statem section 25.2.2 The failure effects of the speed suthorized statem section 25.2.2 The failure effects of the speed suthorized statem section 25.2.2 The failure effects of the speed suthorized statem section 25.2.15.						
Reverser- Suppressor Control Valve 25.2.29.1	Control postitioning of the reverser- uppressor actuators as signaled by PLA when authorized by N2.	a) Science of control value or piston in takeoff position.	SIIO: Not affected Uruise: Not affected Landing: Reverser-suppressor actuation to reverse position not available.	None Rone Cannot retard PLA below reverse idle.	Not affected Not affected Reverse thrust not available.	Not affected Not affected CR	None None Shen rewrise desired, maintain engine at idle, Adjust En level on unaffected
or Reverser- Suppressor Control Valve Piston 25.2.39.2	Provides force to move b) Seizure of control valve to valve or takeoff position. Palson in reverse portition.	b) Seizure of control valve or piston in reverse portition.	Cruise: Not applicable Landing: Reverser must be actuated for this failure to occur. If reverse is selected and failure occurs, reverser suppressor stays in the reverse position.	Not applicable Not applicable Reverser-suppressor remain in reverser position.	Not applicable Not applicable Only reverse Fn available.	Not applicable AF and CR	engines to obtain desired alteraft conditions. None None None Maintain engine at idle or shut off. Adjust En level on unaffected engines to obtain desired affected affected affected affected.
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	Cree Action Depaired		Kone don.	Mone If engine surges, retard FLA to idle or shutoff engine. Adjust F. level on	unaffected engines to obtain desited afrecaft condi- tions.		क्षेत्र के निर्माण
	Folk.'s Effect on Aircraft		Nc: affected	No immediate effect CR If engine surge, AF			OVER TELIMETER DATE
	fullare Effect on langing		Not affected Not affected	No immediate effect Engine may surge during acceleration while in reverse or if maximum for			Anatyzed by: Whates
	Method of Detection		None None	Compressor bleeds remain closed when N2 reduced to idle.			
	Failure Effect on Subsystem		SLTO: Compressor bleeds remain in closed position Cruise: Same as SLTO	Landing: Same as SLTO			
	Failure Mode		Seizure in bleeds closed position		Seizure in bleeds closed position	Seizure in bleeds closed position	
(Continued)	Francties	Provides high pressure air signal to the compressor bleed actuators for positioning the biweds.	Controls positioning Seizure in of the compressor bleed bleeds closed tontrol platon as a position function of N2 and T.		Controls positioning of the bleed control poppet valves as signaled by the bleed pilot valve.	Compressor Bleed Lewore Bleed Lewore Bleed Lewore Compressor algebrage Valve aft pressor algebrage Actuators to close actuators to close the Pleeds. The Pleeds.	
Unitized Control (Continued)	# T	Compressor Bleed Control System 25.2.30	Compressor Bleed Filot Valve 25.2.30.1	10	Compressor Bleed Remote Control Piston 25.2.30.2	Compressor Bleed Resore Control Poppet Valve 25.2.30.3	

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FIA, remote EPR, and remote duct heater fuelflow adjustments may be used as necessary to correct scheduling. PLA, renote EPR, and remote duct heater fuel flow adjustments may be used as necessary. Retard SOL to off position. Adjust Fn level on unaffected engines to obtain desired aircraft 76 9 12 66 Same as SLTO, May also use remote airflow adjustment, Same as SLTO. May also use remote airflow adjustment. Crew Action Loquired Same as SLTO Same as SLTO conditions. Whee all the strength but Failure Effect on Aircraft Possible IFS and CR. Same as SLTO Same as SLTO as SLT0 Same as SLTO Same ర Moderate effect on control scheduling. Minor or moderate effect on control scheduling. feilure Effect sa Engine Control functions will Power reduction, depart significantly from normal scheduling Same as SLTO Same as SLTO Same as SLTO Same as SLTO Control functions may not follow normal scheduling or may drift slightly. Control functions may not follow normal scheduling. Method of Detection Same as SLTO Same as SLTO Same as SLTO Same as SLTO If integral valve closes, servo pressure will be reduced substantially resulting in loss of corrol scheduling authority. Lose proportional regulation and signal medulation and signal medulation to diregral valve. Dependent on flow force on integral valve and pressure forces on both end of the integral valve will saturate closed or open. servo pressure will be increased to control falet pressure. Control schedule accuracy will be rederately impaired. wider pressure range than normal. Control schedule accuracy will be somewhat If integral valve opens, demands, servo pressure will be regulated over a SLTO: Dependent upon seizure position and servo flow Failure Effect on Subsystem Landing: Same as SLTO Landing: Same as SLTO Cruise: Same as SLTO Cruise: Same as SLTO impaired. SLTS: Failure Mede Seizere Sefzure pressure to a constant level above drain pressure for laproved control scheduling Provides direct pro-per jonal regulation of a portion of the serve flow plus pro-vides a modulated pressure signal to the integral valve. Provides integral regulation of the majority of the servo flow as a function of drain pressure level and a modulated pressure signal from the proportional valve. PAR 101538 PG 93779 1788 \$ 300 BOLTHANS 18127 3 40 Regulates server Function Unitized Centrol (Centined) accuracy. Servo Pressure Propertional Valve 25.2.31.1 Ī Regulating 25.2.31.2 Integral Valve System 25.2.31

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	Crew Action Required	Retard SOL to off postrion. Adjust Fn level on un-frected engines to obtain desired aircraft conditions.	Same as SLTO Same as SLTO		•	Same as SLTO. Hay also use remote airflow adjustment,	Sane as \$170	
	Failure Effect on Aircraft	IFS and CR	Same as SLTO Same as SLTO		E	Same as SLTO	Same as S.10	
	failure Effect on Engine	Power reduction	Same as SUTO Same as SUTO		Moderate effect on control scheduling.	Same as SLTO	Same as SLTO Amelyzed by:	ĺ
	Method of Detection	Control functions will depart from normal scheduing.	Same as SLTO Same as SLTO		Control functions may not follow normal scheduling.	Same as SLTO	Same as SLTO	
	Failura Effect on Subsystem	SLTO: Drain pressure is supplied to one end of the integral valve and valve closes. Servo pressure will be reduced substantially reducing in less of control scheduling authority.	Cruise: Same as SLTO Landing: Same as SLTO		SLTO: Control inler pressure is supplied to one end of the integral walve and valve opens. Servo pressure vill te increased to control inler pressure. Control schedule accuracy vill be mocerately impaired.	Cruise: Same as SLTO	ianding: Same as SLTO	
	Failure Mode	Flugged			Plugged			
Unitized Control (Continued)	Function	The integral valve interpressure supply orifice is in series with the drain orifice. The pressure between the two orifices is directed	to one end of the integral valve and varies as a function of inlet pressure	the integral valve of the integral valve or ceeves the modulated pressure signal from the proportional valve. This system ensures adequate force margin and constant response rate for controlling the integral valve.	See previous functional descrip- tion for integral valve inlet pressure supply orifice.		THE CALL SELECTION WAS EAST. CLEAR DA BEAUTY	
Unitized Cont	1	Integral Valve Inter Pressure Supply Orifice 25.2.31.3			Integral Valve Drain Orifice 25.2.31.4		THE CASE OF BOOM AND AN AND	

JTF17 FAILURE MODE & EFFECT ANALYSIS

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Unitized Control (Continued)	(Continued)						
	Function	Failure Mode	Failure Effect on Subsystom	Method of Detection	Failure Effect on Engine	Feilers Effect on Airtraft	Crow Action Required
Drain Pressure Regulating System 25.2.32	Regulates drain pressure (servo sink) to a constant level for improved control scheduling accuracy.						
Proportional Valve 25.2.32.1	Provides direct proportional regulation of a portion of the drain flow plus provides a modulated pressure signal to the integral valve.	Setter	SIIO: Lose proportional regulation and signal modulation to integral valve. Dependent on flow force on on foregral valve and pressure forces on both ends of the integral valve, the integral valve will saturate closed or open.				·
			if integral valve closes, drain pressure will be regulated by the telled valve at a slightly higher level than normal. Control scheduling accuracy will be somewhat impaired.	None	Negligible effect	Negilgible effect	None
			If integral valve opens, drain pressure will be lowered to gas generator pump fullet pressure. Control scheduling accuracy will be impaired to a minor degree.	None	Minor effect	Minor effect	None
			Cruise: Same as SLIO Landing: Same as SLIO	None None	Same as SLIO Same as SLIO	Same as SLTO	None None
Integral Valve 25.2.32.2	Provides integral regulation of the majority of the drain flow as a function of drain pressure level and a modulated pressure signal from the proportional valve.	Selaure	SLIO: Dependent upon seivure position and drain flow, drain pressure will be regulated over a wider than normal pressure range. Control schedule accuracy will be impaired to a minor degree.	None	Mnor effect	Minor effect	None
			Cruise: Same as SLTG Landing: Same ar SLTO	None None	Minor effect Minor effect	Mnor effect Mnor effect	None None
						·	

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ITF17 FAILURE MODE & EFFECT ANALYSIS

Sheet

75 9 17 66 Crew Actine Required None None None None None None VICE DATE NELAMBLE DATE feilure Effect on Aircreft Negligible offect Negligible effect Wegligible effect Regligible effect Same as SLTO Same as SLTO Same as SLTO Same as SLIO Minor effect failure Effect on Engine Negligible effect Negligible effect Negligible effect Negligible effect Same as SLTO Same as SLIO Minor effect Same as SLTO Same as SLTO Method of Detection None None None None None None SLIO: Servo pressure supply pressure is supplied to one end of the integral valve and valve opens. Drain pressure is lowered to gas generator pump inter pressure. Control scheduling accuracy will be impaired to a minor degree: SLTO: Drain pressure is supplied to one end of the integral valve and valve closes. Drain pressure will it regulated by the fillief valve at a slightly higher level than normal. Control scheduling accuracy will be somewhat impaired. SLTO: Drain pressure regulated by
The relief valve at a
slightly higher level than
normal. Control scheduling
accuracy will be somewhat
impaired. Failure Effect on Subsystom Landing: Same as SLTO Landing: Same as SLTO Landing: Same as SLTO Cruise; Same as SLTO Cruise: Same as SLTO Cruise: Same as SLTO Failure Made Plugged Rusture Plugged See previous function- F al description for integral valve drain pressure orifice. The integral valve drain pressure orifice sero regulated pressure sure supply orifice. The pressure between the two orifices is directed to one end of the integral valve and varies as a function of drain pressure level. The pressure level. The other end of the integral valve receives the modulated pressure signal from the proportional valve. This system chautes adequate force margin and constant response rate for controlling the Provides an absolute pressure reference for the proportional valve so that drain pressure is regulated to a fixed level. 8+ 2 4421 helitel-1000 501 8 mli 11110 04 protot wa. Unitized Control (Continued) Servo Regulated Pressure Supply Orifice 25,2,32,4 Integral Valve Drain Pressure Orifice 25.2.32.3 Proportional Valve Evacuated Bellows 25.2.32.5

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JTF17 FAILURE MODE & EFFECT ANALYSIS

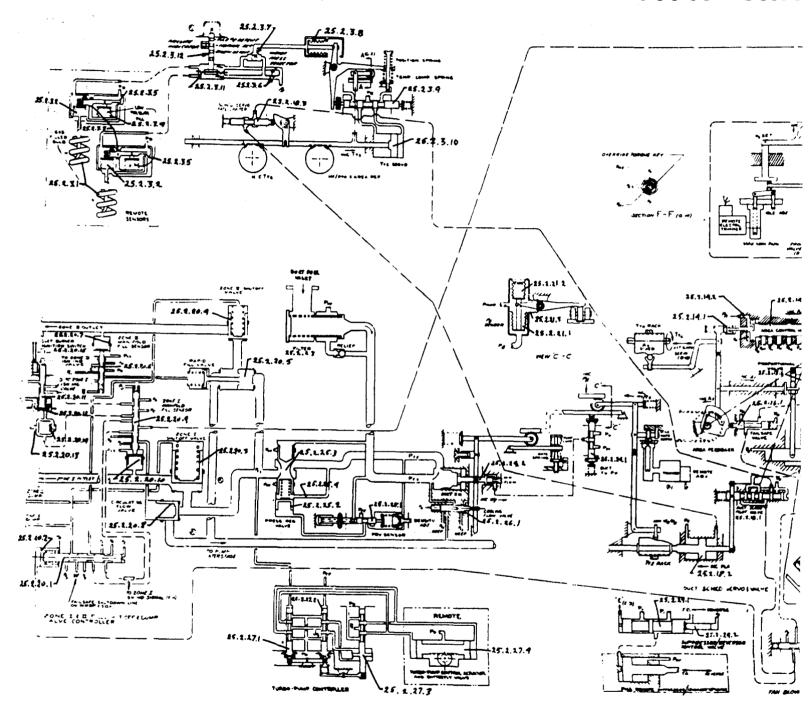
JTF17 FAILURE MODE & EFFECT ANALYSIS

Total Control	Function	Failure Made		Sailers Effect on Septembers	Method of Vetection	LOUIS NA CLIECE AN CARPER		_	-
The trua! Bypass System 25,2,33	Bypasses a portion of the gas generator control pump interstage certur fuel tanks when control inlet fuel temperature from percular seaches a present level to prevent fuel temperature from becoming excessive. A gas generator fuel level bias varies the initiation of bypass for test as the the bypass occurs at a lower fuel temperature at low levels of gas generator metered fuel flow.								
Thermal Bypass Valve PAlot 25.2.33.1 or Thermal Bypass Valve 25.2.33.2	Provides signal to position the thermal bypass valve as signaled by the fuel temperature sensor valve. Positioned by the pilot valve to port all bypass fuel to	Seizure in bypass to tank position Seizure in bypass to tank position.	Cruise:	Not applicable Not applicable Not applicable Not applicable Not applicable Not there a line of the bypass position. If seizure occupits, the valve will remain it. this position after seizure.	Not applicable Not applicable None Tree Tree Not applicable None	Not applicable Not affected Not affected Not active Not applicable	Not applicable Not affected Not affected Not applicable	None None None	
or Thermal Bypass Valve Piston 25.2.33.3	pump interstage or pour part of this fuel to tank. Provides positive force to load the valve in the non-bypass direction.	Setzure in bypass to tank position.		ar central de Jou	ar or ar dda a cox				
fuel Icmpera- ture Sensor Valve 25.2.33.4	Senses control inlet fuel temperature and provides a usgnal to the pilot valve proportional to fuel temperature.	Seizure in bypass to tank position.							
Filot Valve Supply Fixed Orifice 25.2.33.6	Permits modulation of pressure signal to the pilot valve by the fuel temperature sensor.	Plugged							
#31. 11110 00 000,0 . wal	Feb. 0008 90 0111 112 1 2 30 400 111 1 4 1 1 1 1 1 1 1								0 00

ITF17 FAILURE MODE & EFFECT ANALYSIS

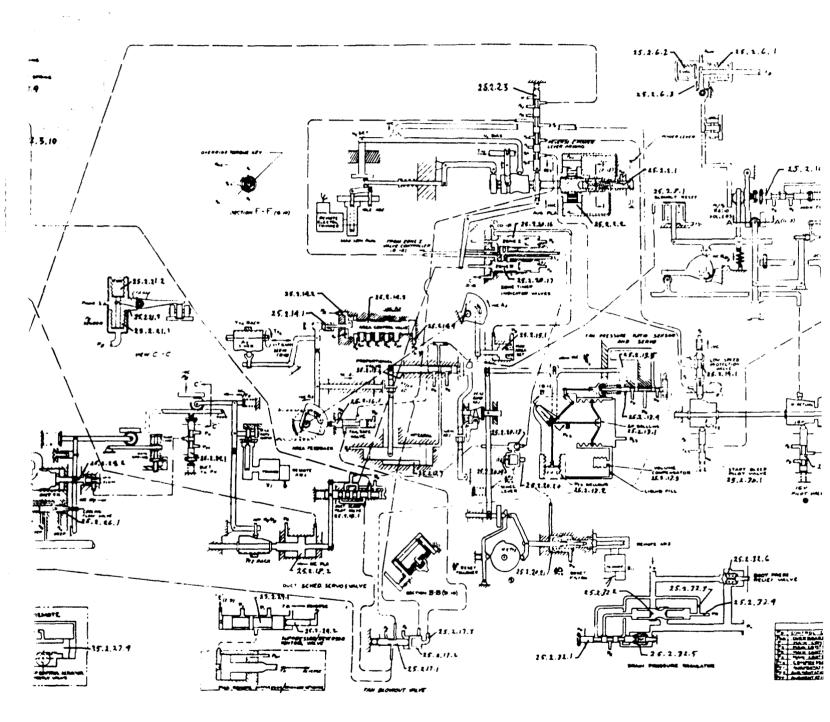
	Crew Acties Bequired	None	None An increase in N2 during decent will	be beneficial in reducing engine oil temperature. Adjust F level on	obtain desired air- craft conditions.			None	None	Non e
	Failure Effect on Aircraft	Not affected	Not affected CR		Not affected			Not affected	Not affected	Not aff ected
	Failure Eilect on Engine	Not affected	Not affected During deacent engine oil temperature will be higher	than normal	Not affected			Not affected	Not affected	Not affected
THE STATE OF	Method of Detection	None	None Engine oil tempera- ture higher than	normal during descent.	None			None	None	None
	Failure Effect on Subsystem	SLTO: Thermal bypass valve remains in non-bypass position.	Cruise: Same as SLTO During descent where thermal bypass valve	normally scheduled to by- pass position, tuel temper- ature will increase higher than normal.	Landing: Not affected		A	SLIO: Fuel bypass to tank will be initiated at lower fuel temperature than normal	Cruise: Same as SLTO	ing: Same as SLTO
	Feilers Mode	Sefzure in non-bypass	position	Seizure in non-bypass position		Seizure in non-bypass position	Sefzure in non-bypass position	Plugged		
(Continued)	Function	See previous description		Sec previous description		See previous description	eSce previous description	Permits variation in fuel temperature signal to the thermal bypass	valve pilot valve as	Anction of gas generator metered fuel flow level.
Unitized Control (Continued)	Hea	Thermal Bypass Pilot	Valve 25.2.33.1 or	Thermal Bypass Valve 25.2.33.2	o	Thermal Bypast Valve Pistra 25.2.33.3	or Fuel Temperiture Sce previous Sensor Valve description 25.2.33.4	Fuel Lavel Bias Orifice 25.2.33.5		

JTF17 UNIT

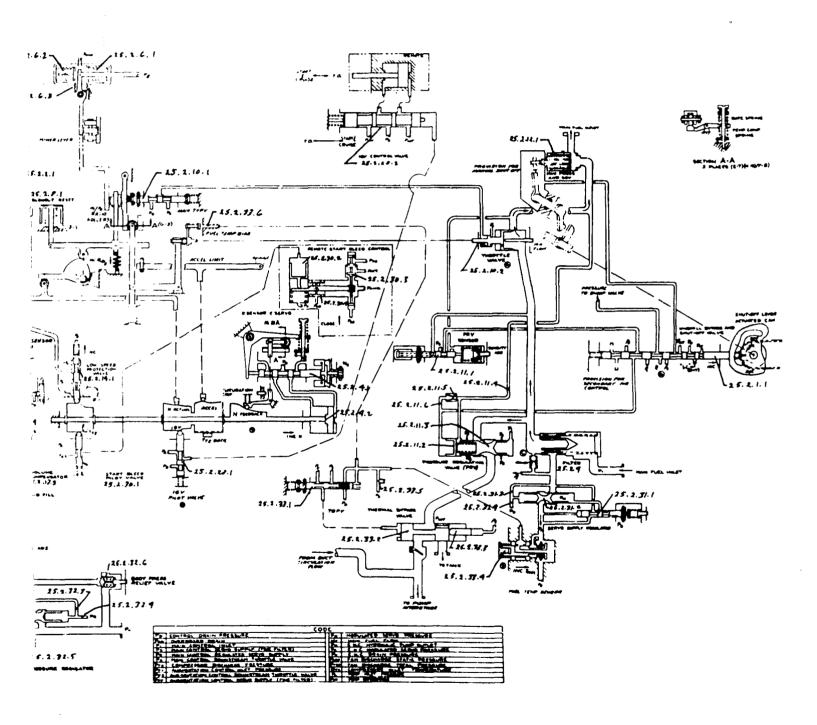




JTF17 UNITIZED CONTROL SCHEMATIC



CHEMATIC



7

25.3, 25.4, and 25.5 FUEL MANIFOLD DRAIN VALVES

. Description

Fue! manifold overboard drain valves are installed in the gas generator engine. These valves open after fuel shut-off to drain residual fuel from generator shutdown fires. The three valves, which are all of common P&WA the unitized fuel control. The valve assembly consists of a sliding gate fuel manifold and in each of the duct heater fuel manifolds of the JTF17 design, are automatically actuated by individual hydraulic signals from the manifolds and nozzles and thereby prevent internal coking and gas valve actuated by a hydraulic piston. A cross-section view of the manifold drain valves is presented following the analysis of the valves.

ITF17 FAILURE MODE & EFFECT ANALYSIS

Same as 5£70

If sefaure occurs after an engine shut down, reduce and maintein 50£ in 0ff position. Acjac En level on unaffected engines to obtain desired aircraft conditions. 35 111.66 fire, motor engine on starter with SOL in Off position. Crew Action Required If have shut down Not Applicable. Same as SLTO None None William Paris Michola Bands Š Same as SLTO
If seizure occurs
after an engine shut
down: CR. Failure Effect on Aircraft Not Applicable. Not Affected. Not Affected. CR Not Affected. Not Affected, Same as SLTO Same as SLTO Same as SLIO Same as SLNO
If seizure occurs after an
engine shut down, gas generator cannot be started. May have shut down fire in gas generator combustion section. Not Affected. Naximum Fn is available if desired. Eventual coking of Lone I fuel nozzles. Failure Effect on Engine Analyzed by: Not Applicable. Not Affected. Not Affected. Not Affected. Same as SLIO Same as SLTU None
On engine shut down,
no fuel dump from gas
generator overboard Same as SLTO
If seizure occurs
after an engine shut
dewn, gas generator
cannot be started due
to loss of fuel overboard. On duct heater shut down, no fuel dump from Zone I overboard Method of Detection Not Applicable. Same as SLTO Same as SLTO Same as SLTO None None Cruise: Same as SLTO
If this seizare occurs
after an engine shut ad
down, attempted restart de
vill result in most gas co
generator metored fuel
flow being dumped through bo Landing: Not Affected.
Maximum duct heater fire!
flow is available. Not affected during Just heater operation. On duct heater shut down, residual fuel will not be drained from the Zone I SLTO: Not Affected.
This is normal gas generator operation position. Nuc Applicable, Overboard drain must be closed for this condition, Same as 51.70
On engine shut down
residual fuel will
no: be drained from
the gas generator
manifold. Failure Effect on Subsystem Landing: Same as SLIO Cruise: Same as SLTU Cruise: Sam: . s SLTO menifold. Landing: SLTO: SL 70: Seizure in over-board drain closed position. Seizure in overboard drain closed position. Seizure in overboard drain open position. Feilure Mode Seals interstage cavity b) form manifold connection cavity. 4 ₽ actuates gate valve in response to sequenced signal pressure. Sequenced to open rantfold overboard drain prih to drain, residual fiel in manifold there Zone I quet heater shut off. Seals interstage cavity from manifold counction cavity. drain poth to drain revilual fuel in manifold when gas generator shut down. Actuates gate valve in response to sequenced signal Sequenced to open manifold overboard Sheet 1 25.3, 25.4 and 25.5, Fool Manifold Drain Valves pressure. Gas Generator Manifold Prain Valve Duct Heater Zone I Manifold Drain Valve 25.4 or Valve Piston 25.4.2 Piston Gate Valve 25.3.1 Shaft Seal 25.3.3 or Shaft Scal 25.4.3 Gate Valve 25.4.1 ž ö Valve P1 25.3.2 9

JTF17 FAILURE MODE & EFFECT ANALYSIS

Sheet

1	Nea Fraction	Feilure Mede	Failure Effect on Sobsystem	Method of Detection	Failure Effect on Engine	Feilers Effect on Alreads	Core Action Sequined
		b) Sefzure in overboard drain open	SLTO: Not applicable during first portion of SLTO where duct heater is in operation.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.
			For seizure occurring after duct heater shut dorn, subsequent duct heater operation will result in erzatic fuel flow to Zone I manifold due to fuel flow in ermitet gas generator pump interstage fuel plus duct heater metered fuel flow with a large portion of the total fuel flow being dumped through the overbeard drain. Duct heater metered fuel flow intermetered fuel	Intermittent reduc- fron in duct heater fuel flow and duct nozzle excursions. Excessive overboard drain leakage from Zone I manifold drain valve.	Erratic duct burner opera- tion. At nonaugmented FLA: Fn = 65% Fma.	۵ ۲	Reduce to and/or pain- tain norangmented Tha range. Adjust Palevel on unaffected engines to obtain desired aircraft conditions.
	on the same of		Cruise: Same as SLTO	Same as SLTO	Same as SLTO, except Fn = 20% Pma	Same as SLTO	Same as SLTO
			Landing: Not Affected. If maximus Fn desired, same as SLTO.	None	Not Affected. Maximum available Fn limited. Fn = 65% Fnma.	Same as SLTO	None Same as SLTC if naximus Pn desired.
Duct Heater Zone II Manifold Drain Valve 25.5					٠		
Gate Valve 25.5.1	Sequenced to open manifold overboard	a) Sefzure in overboard	SLIO: Not affected during duct heater operation.	None	Not Affected.	Not Affe. d.	None
OF OF	drain path to drain residual fuel in manifold when Zone II duct heater shut off.	drain closed position.	On duct heater reduction to Zone II shut off, residual fuel will not be drained from Zone II manifold.	(m Zone II shut off, no fuel durp from Zone II overwoard drain.	Eventual coking of Zone II apraybars.	8	None
25.5.2	response to sequenced		Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	None
or Shaft Seal 25.5.3	signal pressure. Seals interstage cavity from manifold connection cavity		Landing: Not Affected. Maximum duct heater fuel flow is available.	Sare as SLTO	Not Affected. Maximum Fn is available if desired.	Same as SLTO	None
P.D. 1.410 Dy 070.	PA C 4551 Bellything 800 7 MHz 5.150 Ad 870 Al 184				Analyzed by: Wheelerd	121 10144	374 38 33

JTF17 FAILURE MODE & EFFECT ANALYSIS

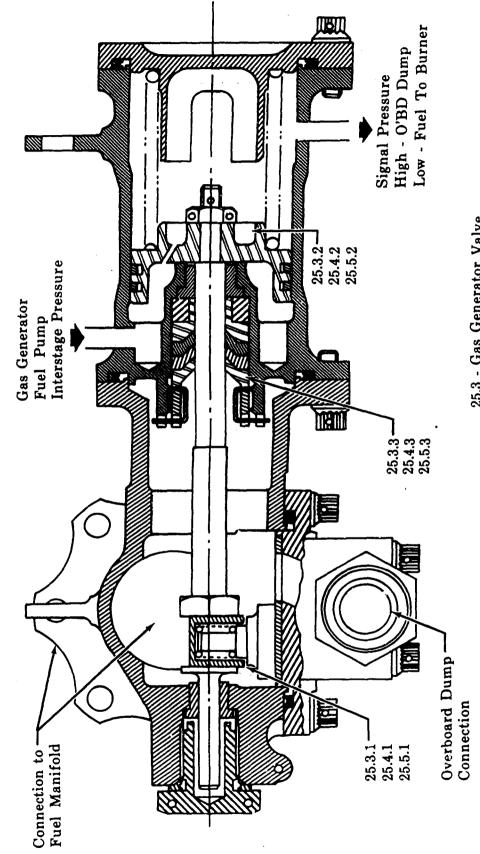
Sheet 5			JTF17 FAILURE MODE & EFFECT ANALYSIS	R EFFECT ANALYSIS		2	-
Fuel Manifold	Fuel Manifold Drain Valves (Continued)						
1	Fraction	Fallure Mode	Fuilure Effect on Subsystem	Method of Detection	failore Effect on Engine	Failure Effect on Aircraft	Crew Action Boquired
		b) Seizure in overboard drain open position.	SLTO: Not applicable during first portion of SLiú where duct heater Zone II is in operation.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.
			For seizure occurring after duct heater Zone II shut		Ercatic duct burner opera- tion at zone transfer and	AF and CR	Reduce to and/or maintain Zone I
			oir, subsequent duct heater operation above zone trans-fer results in erratic fuel	intermittent reduction in duct heater fuel flow and duct nozzle	Above. At zone transfer: Fn = 90% Frms.		augmented FLA range or lower. Adjust Fn level on un-
			flow to Zone II manifold due to fuel flow in system comprised of intermittent	excursions. Excessive overboard drain leakage from Zone 11 manifold			affected engines to obtain desired air-
			gas generator pump inter- stage fuel plus duct heater merered fuel flus uith	drain port.			
			large portion of the total fuel flow being dumped through the overboard dusin				
			Zone I metered fuel flow intermittently varied. Duct heater fuel flow inter-				
			mittently reduced. Total airflow bias reset intermittently activated.				
			Cruise: Same as SLTO	Same as SLTO	Same as SLTO except for cruise: Pn = 80% Pnma.	Same as SLTO	Same as SLTO
			Landing: Not Affected, Maximum duct heater fuel flow not available.	Same as SLTO	Not Affected, Maximum available Fn limited. Fn = 90% Fnns.	Same as SLTO	None, Same as SLTO if maximum En desired.
FALLURES WITH	COMMON EFFECTS FOR CAS GEN	NERATOR AND DUCT	FAILURES WITH COMMON EFFECTS FOR CAS GENERATOR AND DUCT HEATER ZONE I AND ZONE II MANIFOLD I	BRAIN VALVES			
Gate Valve 25.3.1 25.4.1 25.5.1	Sequenced to open manifold overboard drain path to drain residual fuel in manifold when the	Valve Leakage (overboard dvain closed pusition).	SLTO: Manifold fuel leakage overboard. Loss of fuel dependent on leakage rate.	Excessive overboard drain leakage from drain volve when the applicable system is in operation.	Dependent on leakage rate. Experience with this type of valve has shown performance not affected.	ő	None
	applicable system		Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	None
	aud oir.		Landing: Same as SLIO	Same as SLTO	Same as SLTO	Same as SLTO	None
Shaft Seal 25.3.3 25.4.3 25.5.3	Seals interstage cavity from manifold connection cavity.	Excessive leakage.	SLTO: When applicable system operating, loss of manifold fuel into intertage cavity. Loss of fuel dependent on leskage rate.	Excessive overboard drain leakage from drain valve when the applicable system is not in operation.	Dependent on leakage rate. Experience with this type of seal has shown performance not affected.	ő .	Sone
			When applicable system not operating and gas generator pump intertage pressure available (including streat boost pumps or with engine shut down), loss of interstage fuel				·
Fas 167648 PG 4173 115	*** 1950 *** *** *** *** *** *** *** *** ***		free manifold cavity and then out overboard drain. Loss of fuel dependent on leakage rate.		Amohned by: Walnut	When pill Resument pills	12 0 1 1 1 66

See .

JTF17 FAILURE MODE & EFFECT ANALYSIS

	Cree Action Depaired								9710 3/2
	5	None	Mone	Kone	None	None		 ····	<u> </u> 3
	Failure Effect on Aircraft	SLTO	SLTO	No immediate effect.	No immediate effect.	No immediate effect.			10 10 THE
	1	Same as SLTO	Same as SLTO	No fame	No fume	No trans			Will.
				à a					Villan Insu
	failere Effect on Engine	Same as SLTO	Same as SLTO	No immediate effect. May eventually coke within chamber cavities.	Same as SLTO	Same as SLTO			Analyzed by:
	Method of Detection	Same as SLTO	Same as SLTO	None	None	None	,		
	Failure Effect on Subsystem	Cruise: Same as SLTO	Landing: Same as SLTO	SLTO: If contamination plugs orifice, loss of cooling flow.	as SLTO				
	Failura Mode			Contamination					
in Valves	Fraction			Maintain cooling fuel flow within the signal cavity and interstage	cavity.				Pes (1771 ASTANTAN 1980 VOUTERAVIER 17727 7 44
Fuel Manifold Drain Valves	free			Valve Piston Cocling Flov Orifice		25.4.2			# # # # # # # # # # # # # # # # # # #

Fuel Manifold Drain Valve - Cross Section



25.3 - Gas Generator Valve 25.4 - Duct Heater Zone I Valve 25.5 - Duct Heater Zone II Valve

25.6 BUCT HEATER FUEL PUMP

A. Description

trol and the fuel injection system, to the duct heater combustor where it is The duct heater fuel pump supplies fuel, through the unitized fuel conflow air turbine. Use of this variable speed capability permits operation of the pump at reduced speed for most of the flight regime. The speed is modulated to produce only the pressure rise necessary to provide the duct burned to produce thrust augmentation. The pump assembly consists of an heater fuel flow required for the specific altitude and Mach number coninducer boosted centrifugal pumping element which is driven by an axial ditions.

manifold and is regulated by a duct pump controller. This controller varies fuel control. The pump controller is described as part of the unitized pump speed as required to produce only the output pressure demanded by Turbine drive air is supplied from the compressor discharge bleed control.

at the turbine discharge if an overspeed condition develops, thereby reducing discharge. This device, which does not require moving parts or a pump speed the available turbine horsepower. Increased turbine discharge swirl angle associated with overspeed initiates a vortex which produces an aerodynamic sensor, aerodynamically limits pump overspeed by creating a back pressure Overspeed protection is provided by a vortex venturi at the turbine restriction to turbine discharge airflow.

through an interconnecting shaft. Fuel is force fed into the impeller by low-speed inducer provides excellent pumping characteristics at very low an inducer located upstream in the fuel inlet housing. The inducer is driven at one-sixth of turbine speed by a planetary geared drive. The The centrifugal pumping element is driven directly by the turbine fuel inlet pressure levels. Fuel is used to lubricate and cool the bearings, seals and inducer spee reduction gears. This feature eliminates the need for an external oil supp and scavenge system, and also precludes the possibility of depleting or diluting the engine oil supply in the event of turbine end or impeller end shaft seal failures.

A cross section of the pump is presented following the analysis of the pump.

JTF17 FAILURE MODE & EFFECT ANALYSIS

Ī	Fraction	Failure Mode	Failura Effect on Sobsystom	Merhed of Detection	Failure Effect on Engine	Feilere Effect on Airtroft	Crew Action Required
Bearings (3) 25.6.1.	Support Mein Laping Shaft	Seirure	SLIO: Pump may seize due to bearing failure resulting in loss of duct heater fuel flow. Pump controller will schedule pump turbine air supply control vaive to fuil open position.	if pump seizes, loss of duct heater fuel flow	If pump seites, duct heater vill flame out and augmenta- tion vill be lost due to loss of fuel flow. Engine bleed air to pump turbine vill be increased due to full open position of air control valve P = 60% Fmma	If pump seizes, AF and CR	If pump seizes, reduce to and/or maintein non- augmented PLA tenge. Adjust Fn level on un- sifected engines to obtain desired air- craft conditions.
			Cruise: Same as SLTO	Same as SLTO	Same as SLTO except F. = 20% France In addition oil temperature vill increase and may even- tually exceed limits due to loss of duct heater oil cooler fuel flow	Same as SLTO Also may have IFS	If pump seites, reduce to and maintenin non-angusered PLA range. Adjust P. level on un-affected engines to obtain desired all temperature. If necessary to maintain oil temperature list, reduce all-arts speed to subsonic conditions.
			Landing: Not affected. If pump seites, duct heater fuel flow not available	Not affected	Not Affected. If young seizes, maximum available Fn limited to SLTO conditions.	Same as SLTO	Mone If pump seizes and maximum fn desired, sene as SLIO.
Fuel Seal 25.6.2	Seals Turbine end c. Main 'umping Shaft	Bellows Failure	SLTO: Performance not affected. There will be a loss of tuel through the overboard draft. Harough the overboard draft. Markum fuel loss approximately 100 pph.	Excessive overboard drain fuel leakage.	Not affected,	ಕ	Kone
			Cruise: Same as SLTO	Same as SLTO	Not affected.	Same as SLTO	Кове
			Landing: Same as SLTO	Same as SLIO	Not affected.	Same as SLTO	None
Netering Orilice 25.6.3	Meters Fuel supply to beatings for lubrica- tion and cooling	Contamination	SLTO: Possibility of contamina- tion remote because orifice is protected. If contami- nation occurs to the extent that complete fuel flow loss occurs, bearings will eventually fail and pump may seize resulting in loss of duct heater fuel flow. Pump controller will sched- ule pump turbine air supply control valve to full open position.	If pump setzes, loss of duct heater fuel flow	If pump seizes, duct heater will flame out and augmentation tion will be lost due to loss of due! floid of due! for pump turbine will be increased due to full open position of air control valve. F. = 60% Fina	If pump seizes, AF and CR	If pump seizes, reduce to and/or maintein non-augmented PLA range. Adjust Fa level on un-affected engines to obtain desired airtraft conditions.
M31/ 1/110 04 0201	00 1 1511 NETTHEFOR THE M 400 POINTERNIER 1511 1 00				Anadyzed by: Whitesa	11×116 20 9/1×116	116 ONE 911-1611

JTF17 FAILURE MODE & EFFECT ANALYSIS

Duct Heater Fuel Pump (Continued)

No. 2 of 2

If pump seizes, reduce
to and maintain nonaugmented PLA range.
Adjust F, level on
undfected engines to
obtain desired aircraft
conditions. Monitor
engine oil temperature.
If necussary to maintain
oil temperature limit,
reduce aircraft speed to
subsonic conditions. Core Action Required None If pump seizes and maximum F_n desired, same as SLTO. None None None None None None None Feilers Effect on Aircraft Same as SLTO Also may have IFS Not Affected. Not Affected. Not Affected. Not Affected. Not Affected. Same as SLTO Not Affected. Not Affected. Not Affected. Not Affected. Same as SLTO except F. "
20% Firms. In addition oil
temperature will increase
and may eventually exceed
limits due to loss of duct
heater oil cooler fuel flow. Not Affected.
Maximum Fn is available as long as aircraft boost pumps operate. Not Affected. Maximum F_R is available as long as aircraft boost pumps operate. Maximum F_n is available as long as aircraft boost If pump seizes, maximum available Fn limited to SLTO conditions. Not affected as long as aircraft boost pumps operate... Not affected as long as aircraft boost pumps Not affected as long as aircraft boost pumps Failure Effect on Engine Not Affected. Not affected. Same as SLTO Same as SLTO Same as SLTO operate. operate. Marked of Detection Same as SLTO Same as SLTO None None None None None None None None None Inducer drive will shear and inducer becomes inop-erative. The main stage will continue to operate. Inducer becomes inopera-tive. The main stage will continue to operate. SLIO: Inducer becomes inopera-tive. The main stage will continue to operate. Not Affected.
If pump seizes, duct heater fuel flow not available. Fullure Effect on Subsystem Landing: Same as SLTO Landing: Same as SLTO Cruise: Same as SLTO Landing: Same as SLTO Cruise: Same as SLTO Cruise: Same as SLTO Cruise: Same as SLTO Landing: SLTO: SLTO: Failure resulting in seizure of inducer Feilure Mode Seizure Shear Connects Inducer Shaft to Main Shaft Reduces Inducer speed relative to pump speed. Support Inducer Fanction Bearing S (4 Antifriction) (3 Sleeve) 25.6.5 Orifice 25.6.3 (Cont.) Gear Train 25.6.6 Splined Connector 25.6.4 5 Ketering

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pumps operate.

25.7 HYDRAULIC PUMP

A. Description

The hydraulic pump is an engine driven, reciprocating multiple piston fuel at the required flow rates with a pressure rise across the pump of fuel pump that is utilized to provide the engine hydraulic system with 1500 psi.

in hydraulic fuel flow necessary to position and control the duct nozzle Integrator and proportional servo valves control the pump cam plate to maintain a constant 1500-psi pump discharge pressure. The variation area and the reverser-suppressor is met by varying the stroke of the pump pistons.

in the extreme retracted position. This design feature also takes advangeometry of the spherical cam plate face and convergent piston axes significantly reduces the side loading applied to the pistons when they are times, assisting return of the pistons during the suction strokes. The cam plate through piston shoes. Auxiliary cam plates, which are loaded tage of centrifugal force to help retract the pistons and minimizes the Two rotors are driven and supported by a common shaft, each having nine equally spaced pistons, and reciprocated by a common nonrotating by rotor springs, hold the piston shoes against the cam plate at all pump volume by reducing the diameter of the valving interface.

is located on a diameter of the cam plate. A shimmed stop screw limits The cam plate angle controls the displacement capacity of the pump. the maximum cam plate angle to provide the desired maximum piston dis-The cam plate is supported by two trunnion bearings on an axis, which placement.

cam plate angle with two concentric actuator pistons which act in opposition integral and proportional control for stable dynamic pump response through-Variable delivery at constant pressure is províded by controlling the flow rate. The pistons respond to pump output pressure level as sensed to a return spring. The spring drives the cam plate toward full stroke and provides the required rapid response to demands for increased fuel by their respective control valves. The two control valves provide out the required operating regime of this application.

actuator piston. The physical arrangement of the actuator pistons provides Each of the sensing control valves modulates the pressure to its "summing" action without structural linkages.

spring and the reaction of pump delivery pressure on the end of the valve. control valve is nulled by only the balance of an adjustable reference the inner piston is controlled in virtually an integral action.

feedback spring as well as delivery pressure and a reference spring force. proportional action. This control valve senses piston position through a The outer actuator piston is controlled in a similar manner, but in a

The combined action of these servocircuits is proportional in any transient, except at equilibrium. Sealing and valving of the main flows of the pump are provided by ported insert plates located at the face of each rotor. Hydraulic pump discharge fuel flows through an integral, 10-micron full-flow filter, with a differential pressure actuated bypass, which relieves if the pressure drop through the filter exceeds 20 psi. The external drive spline is forced oil lubricated by the engine oil lubrication system.

A cross section of the pump is presented following the analysis of the pump.

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Sheet B. AMALYSIS 25.7 Hydraulic unp	đ _e		JTF17 FALLURE MODE & EFFECT ANALYSIS	& EFFECT ANALYSIS		*	2
Hem	function	Failure Mede	Fallura Effect on Subsystem	Method of Detection	fallure Effect on Englace	Failure Effect on Aircraft	
Rotor shaft Bear- ings (2) 25.7.1	Support rotating rotor shaft,	Buering	llure loss		Nj higher than normal. Yn - 90% Frma	AF and CR	A do s
Cam Plate Shoe Retainer Bearings	Retention of cam plate shoe retainer and		Cruise: Same as SLTO	Same as SLTO	Same as SLTO except Pn = 85% Firms	Same as SLTO	, , , , , , , , , , , , , , , , , , ,
25.7.2	the retainer during cam plate angle . Changes.		Landing: Same as SLTO In addition, reverser- suppressor actuation not available.	Same as SLTO In addition, reversor- t suppressor cannot be actuated.	Some reduction in Fn. Ni higher than normal. Reverse Fn not available. If maximum Fn desired, same as SLTO.	Same as SLTO	Adden reverse adden second sec
History (18)	Fumping elements to provide high pressure hydraulic fuel.	Single pieton sedzure in bore.	SLTO: Piston shoe disengages from Duct nozzle operation hoe retainer. Steady-state may be slower than pump performance not normal. affected. Outling transient operation (actuator displacement) maximum pump capacity reduced approximately SX resulting in decrease in actuator system reapone. May result in subsequent hydraulic pump deterioration.	Duct nozzle operation te may be alever than normal.	bo alover than normal.	5	S
			Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	S.
			0.175 es surs : 8ujque'i	Same as SLTO Hoverent of reverser- suppressor may be alover than normal.	Same as SLTO Movement of reverser- suppressor may be slower than normal.	Same an SLTO	Š.
Proportional Pilot Valve 25.7.4 or Proportional	Controls proportional actuator to provide fas pump response for large hydraulic systen demands.	Scirure far. argr	SLTO: Steady-state and slow transient conditions of hydraulte system are not appreciably sifected. Fast transient response is locressed.	Dict nozzle operation may be alover than normal and may tend t to fluctuate.	Duct nozzle operation may be alover than normal and may tend to fluctuate.	 5	Sign Park
Actuator 25.7.5	ing of the cam plate actuator for fast pump		Cruime: Same as SLTO	SAEC BE SLTO	Same as SLTO	Same as SLTO	Seco
	response to sarge equipula system demands.		Linding: Same as SLTO Novement of reverser- suppressor may be slower than normal,	Same as SLTO Movement of reverant suppressor may be slower than normal.	Same as \$1.00 bovement of reveraer- suppressor may be slover than normal.	Same as SLTO	<u> </u>
	A 1 1710, Mail 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	_	_		Analyzed by: //	Man Jules The Mandelle	

Slover than normal PLA menyments, particu-larly during duct burner operation, vill assist the hydralic pump in meeting demand require-ments.

Slover than normal PA acvecint, particu-larly durfing duct heate operation, vill assist the hydrauls pump in meeting decand requirements.

Same as 9LTO

Same as SLTO

Same as SLTO Same as SLTO

Adjust PLA to obtain desired landing An. If revorse In desired, retard PLA to idle and adjust In level on unsificated estimate to obtain desired aspersit conditions. If maximum SLTO.

Adjust 1 level on unaffected engines to obtain desire, aircraft conditions.

Same an SLTO

Crew Action Required

Variation of

The state of the s

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Sheet 1 Hydraulic Pusp (Continued)	ont found)		JTF17 FAILURE MODE & EFFECT ANALYSIS	& EFFECT ANALYSIS		ż	No ol
	Function	Foilure Mode	fallure Elfact on Subiystom	Method of Detection	failure Elfect on Engine	Fellere Effect on Aircraft	Crew Action Required
Integral Filot Valvo 25.7.0	Control the cam plate actuator to maintain a constant pump pressure rise.		SLTO: Hydraulic pressure regula- tion is accomplished by proportional syster and pressure will tend to fluctuate.	Dict north vill tend to fluctuate.	Duct nozzle vill tend to	ಜ	None
			Crutse: Same as SLTO	Same as SLTO	Same an SLZO	Same as SLTO	Same an SLTO
			Landing: Same as SLTO	Same as SLTO	Sam as SLTO	Same as SLTU	5 am at 5170
Cam Flate 25.7.7 or Cam Plate Actuaror Praton 25.7.8	Variable ungle fixed cable that provides pinton .visprosation as the platon rotors rutate. Positions can plate to maintain flow and pressure at demand level.	a) before (low flow steady- state post- tion,	SiTO: Hydraulic press.re level may buet nozzle movement increase and fluctuate duramy may be slower than ling steady-state conditions. normal and may fluct for transfern conditions, ate. pump will not be able to resupond to increased flow demand resulting in pressure lower demand resulting in pressure lower demand resovery.	Duck nozzłe movezent may be słower than nozmał and may fluctu- ate.	Duct nozzle movement may be alover than normal and may fluctuate. Some airlow error aupyression during duct nozzle transicat of initiating duct heating.	£	blower than normal HLA movementa, particu- larly during duct heerer operation, will assist the hydraulic pump in merting demand require- ments.
			Cruise: Same as SLTO	Same as SLTO	Same as SLTO	Same as SLTO	Same as 51.70
	•		Landing: Same as SLTO Movement of reveuer- auppressor will be slower than normal.	Same as SLTO Mayorent of reversor- suppressor will be slover than normal.	Same as NITO Hovement of reverser- auppressor will be alower than normal.	Same ao SLTO	81,70
		b) Sefrure (high flou- transfent position)	SLTO; Hydraulic pump discharge prenaure increases until overpressure system activates remulting in loss of Hydraulic pressure. Buct no-mie poes to open position,	fluct norge to open position.	Fr 907 Fame	AF and CR	Adjust In level on unaffected engines to obtain desired afreraft conditions.
			Cruine: Same as SLTO	Same as 5LTO	la . 852 l'nma	Sist as SLTO	Same as ALTO
			Landing: Same as SLTO In addition, reverent- suppressor actuation not availabio.	Some as SITO In addition, reverant- suppressor cannot be actuated.	Some reduction in Fn. Ni higher than normal. Reverse Fn not available. If naxisuur in destred, aans as SLTO.	51.10 as 51.10	Adjust PLA in obtain de freed landing Eq. Il reverse by desired, retard PLA to idis and adjust Eq. level eq. unaffected engines to obtain desired aircraft conditions. If excisus In desired, name as SUO.
***	*** ***********************************				Analyzed by: Marca	Waller The State of the	18. 9/1. All

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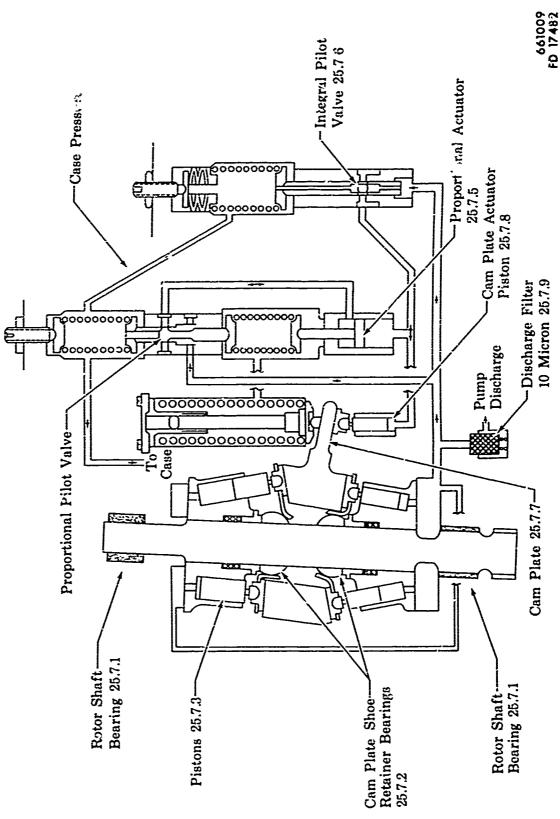
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·	Aircre PDS-20		Ţ				٠ <u>٠</u>
(PSMRAD)	Pratt & Whitney Aircra Pbs-20		Crew Action Required	٤	Same as bLTD	* ** SLTO	The Markey
His Page	» Whit	#	-	Non.		Safe	- 3/12/46
	Pratt 6		failure Effect on Afeceuft	No immediate affect.	No izmediate effect	No ismediatn effect	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
			i	2	NO	2	James !!
			feilure Effect on Engine	No insadiate effect	No framediate effect	No ismediate effect	Analyzed by:
			!	No interest	No femed	Ro formed	-T
		T ANALYSIS	Method of Detection	None Section to the contaminant in the illent and corrective action can be controlled in most instance by foreign to the maintenance.			
		S EFFE		Exects Exec	Hone	None	
		JTF17 FAILURE MODE & EFFECT ANALYSIS	Subsystem	Te drop across Thypass Thypass Tier. This Ti			_
		JTF17 FAIL	Failura Effect on Subsystem	the fliter exceet the filter exceet the filter exceet the filter exceet alone by the filter exceet exceet filter exceet filter exceet exceet for exceet excee	Same as SLTO	Ki Same an SLTO	
			<u> </u>	slīto	Crufmer	Landings	
E			Fellere Modu	Excessive contamination deposited in liker.			
				Fillers Fillers and Fillers and Fillers see Filler.			
E			nt frued)	Contamination protection, Fillers hydraulic pump discharge fuel flov,			***
		_	Nydraulic Pump (Continued) Nem	Hydraulic Pump Discharge 10 Micron Filter 25,7,9			
		Shoot	Hydrau	Mydraul Dischar 10 Mier 25,7,9			i

Physical Company

Hydreulic Pump Schematic



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25.8, 25.9, and 25.10 ELECTRICAL IGNITION SYSTEM

A. Description

Under this condition, the exciter voltage output is increased by the voltage The JTF17 ignition system is composed of two fuel-cooled 400-cycle-perassociated twin is automatically activated for approximately 16 seconds by igniter. To extend the useful service life of the igniters, an inductance voltage is ...en required to ionize the air in the gap to fire the igniter, activated circuit in each exciter fires a gas generator igniter while its igniters electrically connected to the exciters by flexibly shielded lowexelter discharge. The igniter electroass and igniter gap shunt material will erode to some degree after extended service causing an air gap to be tension electrical cables. Each of the exciters contains two capacitanes booster as required to fire the Igniter up to 6000 volts maximum, thereby discharge type independent electrical circuits. Each circuit produces a 4-joule, 3000-volt electrical output to fire the igniter. A filly; crew second alternating current powered exciters and four shunted surface gap type voltage booster is incorporated into each eircuit just prior to the created between the electrodes and the shanting material. An increased the unitized control apon augmentation selection to fire a duct heater considerably increasing igniter life. 1

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checkout at altitude is accomplished using the aircraft ignition-on switches. required to check out the duct heater ignition system at altitude conditions checkouts to minimum nenaugmented operation. Gas generater ignition system prior to descent. A power lever switch in the unitized control limits such electrical discharge to the igniter. The electrical signal indicates that provided for monitor and checkout purposes. A separate aircraft switch is Also included in each exciter circuit is a voltage signal generator which produces a signal voltage whenever the exciter delivers an output the exciter is transmitting spark electrical energy to the igniter and

An electrical system block diagram, exciter wiring schematic diagram, and cross acction of the gas generator and duct heater igniters are presented following the analysis of the electrical ignition syntem.

JIETT FALINE MORE & EFFECT ANALYSIS

Show! | B. AMALYSIS Electrical Ignition System

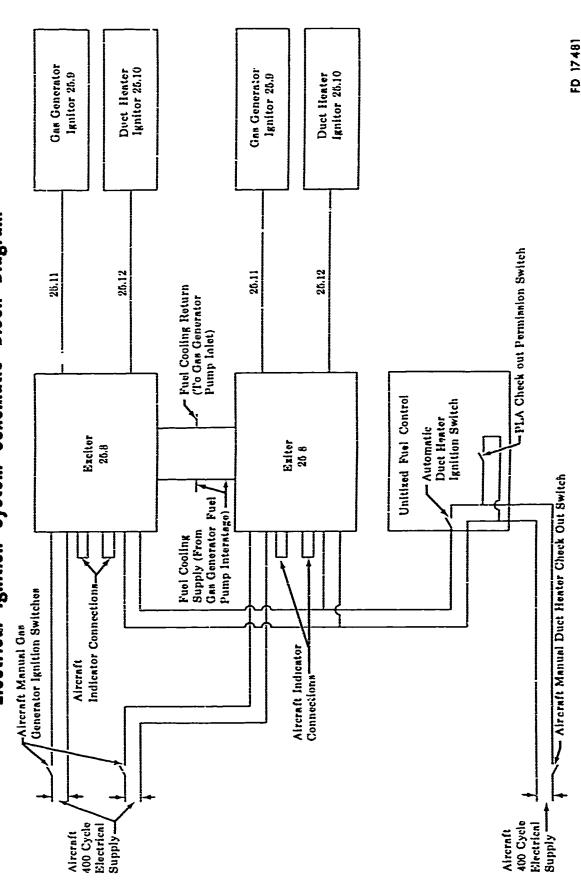
1	- ju	44	Falso Mari as Schaufen	The state of Persons	Colon Hard on Incin	Paller Hart on Month	One Arter Paris
Sections (2)	Lach exciter changes aircraft electrical supply power to a readition suitable to provide spark dis- charge for igalition	Any failure resulting in lack of spark discharge at an igniter.	S.IV: Not affected. Redundant exciter and igniter systems provided.	A voltage signal generator is pro- vided in each exciter to check the gas the man dect hearetor and dect	Not affected. Ralight capability of gas generator and dact hater assured by redundant system.	Not affected. If an exciter, igniter, or lead fails: CL	, garage
;	purposes. Each exciter applies spark ignition energy tt one gas generator igniter and one doct heart igniter.		Cru, set: Same as 9.70 Landing: Same as 9.70	Same as 52.70 Same as 52.70	Same as 92.70 Same as 92.70	Same 4.5 SL70	20 20 20 20 20 20 20 20 20 20 20 20 20 2
Gas Generator Igniter (2) 25.9	Each igniter receives electrical energy from its exciter for spark discharge ignition of the gas generator.					n Makagan na disebagan ng maha	
Duct Beater Igniter (2) 25.10	Each igniter receives electrical energy from its exciter for spart discharge ignition of the doct beater.					n arabaga atta arabaga	
or Leads Leads A Excitors to Gas General (Tables) 25.11 Dect Batter 1gaiters to Dect Batter 1gaiters to Dect Batter 1gaiters to Dect Batter 1gaiters 25.12	Electrical cables used to enchant the discharge energy from the exciters to the igniters.					ene i distribujo sintribujojo, je voje irinė su visi jaugusti programa, jaugustino, mais je, aparagijo programa sintributo au tieri di	
the trace to decid	***				The state of the s	PALL SALVETTE DATE	FR 42 10 16

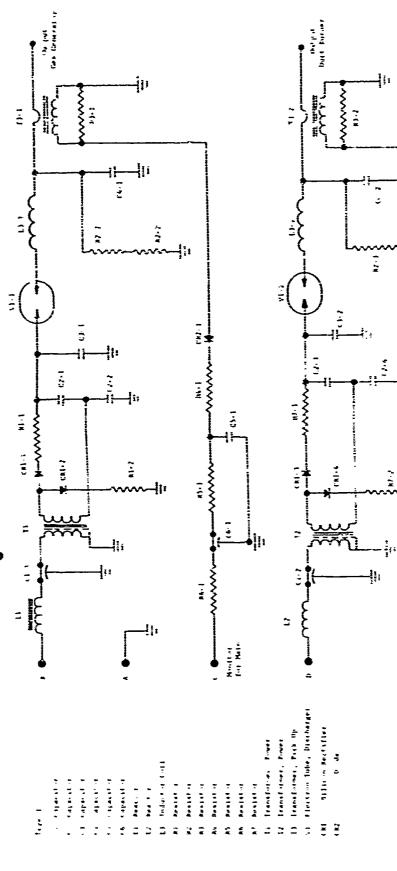
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Electrical Ignition System Schematic Block Diagram





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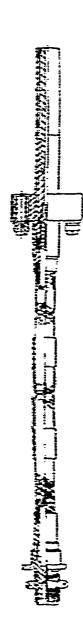
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Gas Generator Igniter Assembly



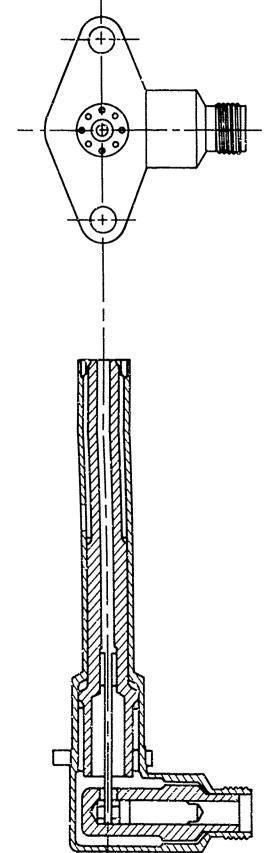




Identification Marking Champion FHE 209-1 PWA 2121798

FD 16623

Duct Heater Igniter Assembly



Identification Marking Champion FHE 210-1

PWA 2117800

Pratt & Whitney Aircraft Pratt & Whitney Aircraft

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Appendix A

INTRODUCTION

revised portions where applicable and supplementary information to reflect PGMA report PDS 2025 did not include the control of the secondary air incorporation of the secondary air control system within the unitized system required for the Boeing installation. This appendix contains The JTF17 Failure Modes and Effects Analysis : rudy contained in control.

A fold-out schematic is located at the end of this appendix so that by prior exposure it may be left in view while reading the appendix. Abrillation of the state of the

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Section 2

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PDS-2025 Appendix A

ITF17 FAILURE MODE & EFFECT ANALYSIS

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Noting high fresh that number perDaring supersonic climb, adjust engine sitilou

Iden of supersonic climb,

station of supersonic climb,

station angmostation will re-match will be less than flow match. Der 80;

stati fin over-tempetature of optimum with some loss aggentation or less
there are jector which will an performance,

climb, Actual engine sirther tobtain desired airthor soich. Use 80% augmentation or less. Crew Actics Required Adjust engine air-flow to obtain desired airflow Adjust engine air-flow to obtain desired airflow Adjust engine air-flow to obtain desired airflow natch. ěů. None Victoria Malle The Matte. Not affected Not all Inlet-engine air-fow match will be these than optimum with a game, loss in performance, loss in perform-Inlet-engine airflow match will be item than optimum with some loss in performer. Follore Effect on Aircraft Inlettengine airfloceatch will be less than optimus with some loss in per-Inlet-engine airflow match will be less than optimum with some loss in per-forwance, Not affected Not affected Not affected No. affected Not affected, Maximum mumber of treatl in over-temperature of the engine ejector which will shorten its life. sense or Signal bailures, of PSMA Report 195-2025. fallure Effect on Engine Anelyzed by: No. affected Not affected Position indicator None Position indicator will show valves open above 240°F T_{T2} Position indicator will show valves open, Merked of Detection Fon on indicator will snow valves remain . losed. loss of press SLTO: The four bypass duct valves Position fidicator sure SAMP AN SLIO Sone None Hone None Grofav: The Try controlled bypass duck valves open. During descert, two bypness to valves will not open with valves result of the where IT2 is below approximately 240°F. Gruise: The SOL controlled hypuss valves open if closed or cannot be chosed if open, SLTO: Not affected,
On climb, the Try controlled
bypass duct valves recain
open linkted of cloting at
approximately 240°F Try. The following to 47 addition to Section I, Component failura Effect on Substition Landing: Not affected Landing: Not affected Landing: Same as 5110 Ciutae: Not affected SLTO: Not affected of SOL con-trolled signal. Loss of pressor of high press Loss of pressure or loss billity of Try Fellure Mode unitized control.

One signal positions

two bypass duct

butterfly values an
a function of Try
and the other signal

positions two bypass

duct butterfly valves
as a function of Soli

position as author
lied by glA. Both

systems control

butterfly value

position using high

position using high duct butterfly valves due positioning ke pressure to open, are at low pressure. Provides force to *************** Cas Cenerator ator Pump Interptage Pressure Posittentny Fuel Pres. Secondary Atilion * Lang 1* Control = 2 7 نَج

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The following is an addition to Section II, 25.2A, Unitized Control Description.

SECONDARY AIRFLOW CONTROL SYSTEM

bypassed through the ducts from the engine inlet to the ejector as a function of power lever angle, shutoff lever position and compressor unitized fuel and area control which controls the secondary airflow The secondary airflow control system is an integral part of the inlet temperature.

incorporate butterfly valves which are positioned by two-position actuators. A value which is positioned by the $T_{\rm t2}$ servo in the unitized luel control. The secondary air bypass system consists of six ducts, each of which ports gas generator control fuel inlet pressure to two of the actuators 240°F (Mach 2.0). Closing these duct., improves performance during the has a check valve to prevent reverse airflow, and four of the ducts to close two bypass ducts when compressor inlet temperature exceeds climb pertion of the flight envelope.

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PDS-2025 Appendix A

> locked with the power lever sequencing valve which prevents closing these Aircraft crew advancing of the shutoff lever sequencing valve in the two ducts whenever engine power is in excess of 80% of maximum augmented unitized fuel control ports gas generator control inlet pressure to two reached in order to optimize engine performance. This signal is inter-The interlock prevents inadvertent closing of the bypass ducts actuators to close two other bypass ducts when cruise conditions are during augmentation conditions at high Mach number which would overtemperature the ejector. thrust.

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PDS-2025 Appendix A

JIF17 FAILURE MODE & EFFECT ANALYSIS

Sheet ! Unitized Control			JTF17 FAILURE MODE & EFFECT ANALYSIS	& EFFECT ANALYSIS		2	Ko of
=======================================	Function	Fallure Made	Follore Effect on Subsystem	Method of Detection	Failure Elfect on Engine	fallura Effect on Arreraft	Crew Action Required
The following ar	revisions to Section I		25.2 Unitized Control Analysis of PAW Report PPS 2025 and replace the applitable portions of the repor	2025 and replace the app	iteable portions of the report		
Shutoff Lever Sequencing Valve 25.2.1.1.	nk for all shut- ve functions. ovides signal from two sec- air bypass duct.	Selaure	Crutee: Not Affected. Control of the SOL bypass duct valves is maintained duc to med'anical counction of sequencing valv. SOL torque vill increase.	None SOL torque Increase to close bypass duct valves.	Not Allected Not Alfected	Not Affected Not Affected	None None
			Landing: Not Affected, Engine can be shutoff with SOL due to mechanical connection of sequencing valve. SOL torque will increase.	SON, torque increas. to shutoff engine.	But Affected	Not Affected	Yone
flower Lever Boost and System 25,2,2.	Provides with minimum input torque, control and power lovel and lower lovel and control of augmentation of reverser suppressor and authorization of son controlled secundary air hypass duct pusitioning,						
Fourt Lever Reast Fourt Fiston 23,2,2,2,2	Provides power boorced retaction of ULA car shaft in response to though control valve.	Se i rure	SLIO; Control system remains at setting existing at time of failure. It, bias of schemie will continus to function.	howr retting.	Angine power remains at secting exterior, at the of failure. To bias of power setting continues to function	CR. If abilitional power dealerd, A.	tone at conditions constitue than of change desired, adjust In teve on marine co- desired alread conditions Engine conditions Engine vitti SOL.
			Gruiso: Same as 5170 In addition, the 50, controlled secondary air bypass duct valves cannot be closed at cruise if setaure occurs at power setting above 80% maxfaun	Saec an MIO Postifon indicator will show by pass duck valves open.	Some as SLTO Not affected.	Same as NLTO Inter engine airtiou match will be less than than op'foum with sore loss in performance.	Same as vITO Adjust engine atiflov to obtain desired airflov.
			Landing: Save co SLIO. In addition, reverser- suppressor actuation not available.	Same as bLTO	Same as SLTD. In addition, teverare thrust not available.	Sase as 51.TO	Nath as NLTO
HE 93.180 to 45051-5 444	The state register, a see that the state of depth two		•		Ambyrod by: " Calcan !!	Jenson Marie Marie	12 1/2/64

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PDS-2025 Appendix A

Sheet I

ITELY FAILURE MODE & EFFECT ANALYSI

telitied Control (Continued)	(Continue)						
<u>.</u>	function	Fallure Mede	failure Effect on Sobsystom	Marked of Detection	fallers Elfact on Engine	Fallors [Mect on Airtraft Grow Action Required	Craw Action Required
HA sequencias	Frovides acquenting of revence-appression, and duce hacter fulli- ation with authority	soleure in zone trans- for position	4.170; Central system not attacted at PLA souting at the of failure (soow transfer) and higher.	Non	Not Affected	None	None
	of low speed protection doct traces and train- doct traces and train- train and authority for sull to close a condary aff bypass doct valves,		is reduced below going. F. Love II fuel flow es and lowers flower ov below normal. On ov below normal. On ant III Advance to antifle in higher, the affiliow bias signal forsal flow case filliow case will not occur.	Normal engine total affilor decreme duriny aone ranafer vill not occur.	As PLA reduc d, eventual active il flamenci. Jens I for lower than normal with Fin lower than normal. Feed on fin Pla All result in a storing fone il augmentation before zone t. ansere PLA postitien.	3	Advance (1A to near concentration of the control of the control of the control of the conditions to obtain desired affected conditions.
			but heater fuel flow cannot but heater cannot be builded "b. P. A until alutoff utlin reduction to eastern approximately 80t. Ny or nonaugmented position trease above 802 will refinite duct heater fuel flow.	But hetter cannot be shutoff with normal reduction to exclaim nonaugnented position.	Bret heater fort shutoff requirent reduction to NOY, By or lower, sobrequent in- crease in Ny above 802, will refinitiate duct heater.	Same at above	If duct brater thutoff draked, reduce N ₂ with FLA.
				Same as \$110 Foiltion indicator will show 80; controlled bypass duct valves open.	Sot Affected	hanc as SATO Interengine afritov eaten vill iv less than eaten vill iv less than for performance.	Same as 5170 Adjust emplor aistlow to obtain desired airtiou match.
			Landing: Not applicable. If duct heater inflated and fallure occurs, same as SLTO. In addition cannot actuate inversor suppressor.	Not Applicable	Not Applicable, If doct Seater initiated and failure occurs, amer as SITO. In addition, reverse by not evailable.	Not Applicable	None 11 dout heater initiated and failure as curs, sare an 'LTO.
		b) Selgure in any position other than (a) above.	For acture in any position (other than in rone transfer position described above), 20.4 strong value to sagnitined in an increasing direction, but actions to restaure in the amount of the control of the sagnition of a castern and account of the control of the c	than in rone transfer po of the only effect will be beve will apply except ctules providing IIA to	attion described above), 39.A. a fiving the equentity valve in the inability to obtain revall attition below sone trans not advanced to 80! power re-	oporty will be mainted an increasing direction to thrust. For before er is not applicable and	ned in an increasing i. For refaure in to in the Zone I ave- the accordaty all
Complement Inter Committee Sensity Vater (2 Sensity Vater (3 Sensity Vater (5.2.)	Compressor fines compressor fines fragerature the first properature dual remote mouth first framors the sense to provide (2 Sensors the sense to provide (2 Sensors the sense to provide (3 Sensors the sense and control postitioning of two secondary air bypass duct valves.						
¬:				-	Analyzed by: Judices 11-14.	11-16 Fr 25/2/6	No The Oliver

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PDS-2025 Appendix A

Sheet 1

JTF17 FAILURE MODE & EFFECT ANALYSIS

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zed Control	Unitized Control (Continued)					1000	
# e#	Percion	Follore Made	failure Effect on Subsystem	Method of Detection	Fellero Elloci on Engine	Tellere Lifett on Aircreit	Crew Action Required
Remote Fr. sensor flapper valve 25.2.8.5 or Kemote Fr. sensor motor hellova 25.2.5.2	Controlled by the gas Contamina [11] built built and bellow (closed to provide a modulated post/forn) fuel pressure signal to the control as a function of \$\epsilon 2 \epsilon	ration (r Kar (fer of bel- ith	SLIOI tentiol Tr2 system at max- from for Tr2 point to. Gos generator furl flow, dut t lie ter fuel flow, dut t ale, compressor bleeds, com- pressor files goide vonce, and Ez controlled secondary at Expose file valves at before the transfer fuel flow response fact with Tr3 is contain at approximately is cuttee response fact.				
or Lightler valve	Modulates It, servo discon as a function of I, (remote sentor signal).	Seffure (11gh F _L 2 position)	During augmentation, doct nozzle acteduted to full open position. Compressor inter guide vomes to starterule position. E.z. controlled accondary air bynas duct valves close. Gas generator and duct heater first fluys decreased, starter for intellitys declarated.	Duct marge full open. Joan generator fuet 110v. duct the set 110v. Hy. T.f. set 110v. T.f. set	Yr. 307 Press	AF and GR	Adjust In lavel on inflected engline to obtain denlined alterati
			Buring nonaugmentation, seme as shove except duct nozale scheduled to 4.5 square feet position,	Hame as above except duct nossle at 4.5 square feet position.	In . 23% luma Augmentation may be initiated and In increased to value above.	Same an alcove	Meintifate augmentation if additional In desired.
		5	Gruise: During augmentation, duct norate area largui than normal, say gener- a or and duct heater fuel flows lower than normal.	Duct nozzle srea Gas generator (ush flor, duct heater, flor, duct heater, furl flor, Ny, Try, and Erg lover than normal.	Fn - ASS lema	Same as SLIO	Same as 5170
			During non-unmentation, same as above except duct norste atheduled to 4,5 square feet foot took took	Same as above except duct nozzle at 4.5 square feet powition.	Fn - 15% Fram Augmentation may be fulfilled and In increased to value above.	Same as SLTO	Samer an SLTO
			buring descent, compressor blacks open and compressor inlet guide varue remain Also, 72, controlled sec- ondary air bypass duct valves remain (losed wien 7, 1 reduced below	Same as above. Also, obstation blusteaur abov I, controlled bypass duct valve closed below 240°F I ₁ ?	Fourt schedulus do not follou normal T, bias as condicions chanke.	Same as 3.70. Also, interespine airlow match vill be less than than optimum.	Redolate PLA to obtain destred descent conditions.
			Landings Same as SLTO	Same as SLIO	Stone Po thanke, If maximum Po dupliced, name as 51,70.	Same as SLTO	Adjust Ir, level with FLA. If maximum Fr. desired, same as SITO.
	ON A CITED WATERCOME OF MAY A MAY FOLD MA MONTH TO THE		- 4	-	Anolyzed by: Villean	Wholes of the middle of the	ic 75 11416
							Tree of the latest the

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PDS-2025 Appendix A

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JIF17 FAILURE MODE & EFFECT ANALYSIS

drived contri	outted control continued.	Failure Mede	Pullure Effect on Subsystem	Method of Detection	Jollyre Ellect on Laylan	feilure Uffect on Abecraft	Crow Action Rospoired
Ig. 44Est valve.	ve si previos functional before flev description	betwee (too It, postition)	Control It, system directed to maximum told fall make position. Gen kennealor luci flou, duel			-	······•
E. Kreelson	Transatta recote betto our mainlated presente signal force to Itz pilot valve.	F. Hove	the acer (net flow, dust notable, compressor bleeds and compressor inte putte vance achoduled to the strength of position for the acer (set flow tresponse sate with TA is concent at approxi- mately %IJU response rate	······································			
			SLIG; fortag augmentation, dust nozele acheduled to full open predition. Ola gener- acer and dust brates fuel flow destrates.	Duct nossie full open, das genurator fuel flow, duct heater fuel flow, N., Try, and hPR lower then notes.	Fn = 705 Puma	A3' And (X	Adjust by bevelon unaffected engines to obtain fested afferant concludes.
			Daring nonaugeentation, ages as above except duct nonair activities to 4,5 aquate feet position.	Same as above except duct morets at 4,5 square feet position.	Fig. 2.12, Pina. Augmentation only he initiated and Pin increased to value above.	Saber an alloyer.	Me institute augmentation 15 additional 15, decised.
	-		busing citimb, it, controlled feature indicator will accondary att bypass duct his valves open above valves do not close and 260°F kgs. compressed falst golds valued remain in 5120 postition.	Frantition indicator will plow values open above 240°F Eq.	Pugine total sirdlow to higher than normal.	Inter-engine airthus natch of 11 hr less than options of th area lore in priformate.	Adjust sught- alstick to oftain deased airtice
			center Some as SLIO except cooperations for Holde varies positioned to SLIO position and Z ₂ controlled except standary air hyposes duct values open	Anne de SECO	Naw as Wilo except during a uniformation in 10° 10° 10° 10° 10° 10° 10° 10° 10° 10°	'same as 4.10	Name on 170, Alvo, one alower than normal ILA and ilation in augmentation reque
	-		fanding. tem at tillo	Name as MLFO	Semer In reduction, If Packfrain In destied, sand as 5510	'ame' as '2.10	Address In Breed Ages of the A
:	: : : : :				Analyzed by: William Timber	species de spiete	A

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PDS-2025 Appendix A

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Unitized Constail (Continued)	(Continue)				-			
e (j	function	Follore Mode	_	follore Effect on Subsystem	Method of Detection	fallure lifect on Ingine	Pollere Illect on Alrevats	Crow Action Required
Terro Meter	Try hervo Pictor Foots tone various cample, 1,1,1,1,10	3ed rure	1017 1017	T _i , arresplator and the T _i control echedules do predictions of selection are relative norsal T _i , will result in the position blue a condition change of a tiles of fallors, change, and tiles of fallors, change and the condition and the off a fallors, that is at the ordition.		Sel effects	Vot affected	# A
				bering a 10-b, control strength of one follow normal T ₂ , sides, Gas generator I's, illow bigher the normal, but header the normal, but header ford they and due normal area here then normal reasin in hilly position, T ₂ controlled secondary attributes duent valven T ₂ controlled secondary attributes duent valven reasin open.	Cor generator fuel libro, No. 17, 198 higher than normal. But heater fuel flow and duel morgels area flow freitten freiten freitten freiten freiten freiten freiten flow accordaty at hypern duet value open above 240°; 1 _° ;	Ly will eventually exceed libers without the action was empty of the action term of the action executed with eventual act or military with a continuity.	I bentually, Al. Ok.	all conversal to red with the bar set of the
			• • • • • • • • • • • • • • • • • • •	Ty serve platon and Typestitionfin of various care will tenden the line position schoolseled at the of fallure. No affect for conditions existing at time of fallure.	Vens for conditions existing at the of failure.	his affer to d	Not affected	E X
				Ny nonaugmented that and landing the propert better links, a remain on state as possiblen and 1/2 as possibled secondary sypass due: valves in , loxed b low 140?	not follow normal Training the secondition that the secondition that the secondition that the second that the	Nower schedules do not fulled interengin, stilled normal T _{L2} bias as conditions match will be lone thange. The options below below 2007 T _{L2} :	lotetengton afrilow with vill to lone than offlwom below 240 ¹³ T _{E21}	Modulate ILA to obtain deflet deseat conditions.
			·	'12' Il parimum F. destrois during lauding, achedules remain of high T _e ; value,	If maximum V, desired, that generated flux, deet heater fuel flux, 3.22, EFR, N, count than normal;	Hakimim) p not available. Fn - 50) fina.	A) and (A	If maxima In Mented, adjust In livel on unaffected engines to obtain dealing confirmations.
			1	Landing) Not affected	Henre	Rot affected		None
# # P P P P P P P P P P P P P P P P P P	***************************************	·		-		Analyzed by: Whiteham	Marine Relation will the strike	1 8 phothe

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PDS-2025 Appendix A

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JTF17 FAILURE MODE & EFFECT ANALYSIS

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<u>3</u>	Pencilen	Pollure Mede	_	fellore	follors Effect on Subaptions	Method of Derection	failure Affect on Englac		Follors Effect on Alecraft	Crow Action Required
following in	The following in an addition to beckion 11 (9.4 Unitized control Analysis of 1964 Report 1798 2075	1 Ch. 2 Wellstand	(outro)	I Analy	yels of lakk Report F	402				
It controlled recordery Atte- flow bypass Bure- Butterfly Valves Fluct Valve	Trovides prestiveing controlled frowther ping for bottom but presents and for bottom but uppers duct filly Valve butterfly valve butterfly valve fillst valve futterfly valve of fillst valve of fillst valve of fillst valve	***************************************	*0.17	Not at Doring Valve hypana postst An acc	Not affected Doring cited, the pilot valve will be forced to bypan dust valves cited postition by the I ₁₂ nervo in accordance with respect	Mone	Not affected Not affected	* *	Not alfacted	None
			100		Not affected, th descent the T ₂ controlled bytass duct balves will remain in the closed position,	Monte and the state of the stat	Not affected. Raximum augmentation betou- 2407 It, at supersonic conditions will aborten life of engine ejector.		Not affected, the descent, falst- engine affilow match will be less than desired daring augor- sonic quaditions below 240°Y 12°	Hone On descent, adjust engine sirilow to obstant devired alrilow match. Below 240°F T. Below 240°F T. to less than MOL. to less than MOL.
			f. and Sng	7	tanding: Not affected	Nerte	Not a farted	ž	Not affected	Cord f Lone . Rone
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							Anulytic by: Assay	1	Vallend at 1146 all all the Market	24/11/4 3/

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PDS-2025 Appendix A

SCHEMATIC OF BOEING SECONDARY AIRFLOW CONTROL SYSTEM

